PREPARATORY AND AFTER TREATMENT IN OPERATIVE CASES

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TO

PROFESSOR JOSEPH D. BRYANT, M.D., LL.D.

IN RECOGNITION OF THE DETERMINING
GUIDANCE EXTENDED, IN THE FIELD
OF WHICH THIS BOOK SPEAKS, TO

THE AUTHOR

INTRODUCTION

The relationship between the physician—*i.e.*, the general practitioner—and the surgeon has undergone a radical change within the recollection of the writer. It is not so very long ago that the practitioner was permitted to stand meekly aside as the eminent surgeon walked out of the patient's house, after pouring forth great wisdom to the gaping family, and later act the part of a human phonograph reiterating again and again the oracular statements of the surgeon.

Since then the practitioner's early educational opportunities have been much increased. He is better educated, better equipped and occupies a position toward his patient and the surgeon which is no longer as objectionable as obtained previously. However, there is still room for improvement in this regard, and the writer feels that the education given the practitioner as the outcome of methods of teaching surgical technic is not such as to place him in the precise position which is his due.

The writer canvassed the position as to just what the fallacy in the relationship of the practitioner to the surgeon is, in the following way. A number of surgeons of ages ranging between thirty-five and forty-five were asked, "How do you feel when a practitioner calls you on the wire to do at once a celiotomy? Do you feel that you can safely go with only instruments and suture material and expect to find everything in proper shape for operation even though the practitioner tells you everything will be ready?"

The answer was invariably in the negative, except in those instances where the surgeon had repeatedly done work for a given practitioner.

Further discussion brought out that the surgeon felt that the feeling of apprehension was qualified by these considerations; that if the practitioner had recently finished a term as interne on the surgical service of a hospital, things were apt to be in reliable shape; if he had had a medical service they were not. If he had been in practice for five years and had not had ample opportunity to take part in surgical procedures he would also probably make defective preparation. If he had been in general practice for ten or more years it was believed that minute instructions were necessary. As to the reliability of the after treatment in the hands of the general practitioner, the belief seemed to be universal that, while the physician was apt to be able to take good care of the general indications as the outcome of his experience, the care of the wound itself would call for more exact instructions.

As a rule, a practitioner is not in a position to control cases of the kind which require major operations, during the first five years of practice, for obvious reasons, and by the time his position becomes such that he can, as the outcome of hard work in a general practice, he has neglected to maintain familiarity with the technic of operative work.

It is the intention of the writer to furnish a work from which the practitioner can draw information with regard to the handling of a case to be operated upon from the time the decision to operate is reached up to the making of the incision, and then take up the case again from the time the operative technic is ended until recovery is complete.

It is to be regretted that human nature leans toward unusual and peculiar indulgences. If the science of healing has established anything, it is proven that infection of operative wounds is due to contamination. This is prevented by sterilization of the field of operation and all that comes in contact with it, and by measures which are firmly established and which universally achieve the object. Yet one need only go into the operating rooms of a number of surgeons to see a frightened assistant being scolded by the operator for not having taken the peculiar precaution which he happens to favor in the technic of anti- or asepsis. This peculiarity, the writer is free to say, is not infrequently the outcome of a desire to pose beyond the measure of most men, and one which it would be well to have the surgeon control. The fact is, that the object is attained in many ways, each of which has its special field of usefulness, and in this connection it is the writer's desire to be of aid to the surgeon in bringing out the applicability of certain methods under certain circumstances. For instance, towels, etc., are certainly rendered absolutely sterile by heat, yet the same object is obtained by immersing them in a solution of mercuric bichlorid for a long time. It need not call forth a dissertation on heat sterilization from the surgeon if he be called to operate on a case where the conditions made heat sterilization less certain than the use of wet bichlorid towels. Especially is this true if the surgeon is called upon to operate under conditions where the necessary apparatus is not available. The ingenuity of the practitioner is here called into play, and this work is intended to aid him in making efficient preparation, and show the surgeon how he can obtain the desired result under the circumstances.

Again, while asepsis has replaced very largely antisepsis, the writer believes that there are certain conditions which make more desirable the use of antiseptic measures, an opinion in which he does not stand alone.

In some instances the ultimate result of an operative effort is marred by avoidable sequels. It is intended to include here advice by which this may be avoided.

During the transitional stage following the more complete education of the candidate for the practice of the healing art, a spirit of commercialism crept into the profession. The practitioner felt that he was acting the part of a feeder to the surgeon. The family paid him a small fee for each visit during the time the diagnosis was being made, and when informed that operation was necessary, hoarded together their money to meet the cost of the operation. In many instances the physician not only lost his case but was ultimately permitted to carry out the end treatment at a nominal pay, which in many instances was not forthcoming because the funds of the patient had been exhausted in paying the surgeon. The practitioner then took his patient to the surgeon, arranged for the fee to be charged, but exacted that he be given a certain proportion of the fee in compensation for bringing the case. How far this percentage business has gone it is of course difficult to say. However, the concealment of an infirmity never contributes to its cure, and there can be no doubt that this sort of thing has been and is constantly done.

Much of this is due to the fact that neither the practitioner nor the patient have been properly educated in the matter. The practitioner has not devoted much energy to keeping in touch with modern methods of preparing patients for operation, and the patient has not been taught to understand that the work connected with or the services necessary in this regard is special work and demands a special fee. More so is this true of the after treatment of operative cases. The surgeon does his operation, takes the fee, and the practitioner is compelled to carry out the after treatment of the case at the usual rate of charge for a visit. Manifestly this is not an equable arrangement, and it certainly stands in a causative relationship to the methods of handling the financial end of the surgical proposition in a manner from which most men shrink, even though it would appear that this was the only way of treating the practitioner fairly.

In cases which do not need immediate operation the surgeon not infrequently sends to the patient a nurse who is familiar with the work necessary for the preparation of the patient, the operating room, and the apparatus necessary. In some instances the surgeon sends an assistant who makes the necessary preparations. Again the general practitioner is placed in an undesirable position, and one which need not be. The general practitioner should be in the position to attend to these matters himself, and thus occupy the position toward the patient and the surgeon that he should.

As far as the preparation is concerned of the patient, who suffers from some complication requiring special preparation, the work to be submitted here is intended to act as a guide, taking up nephritis, diabetes, obesity, tuberculosis, etc., in connection with contemplated operations.

If the patient and the family are made to understand that the surgeon will operate, that his advice with regard to the preliminary and after treatment is at the patient's disposition if required, but that the real carrying out of the measures indicated are in the hands of the practitioner, who is thus an integral part of the procedure, and that this work is entitled to special financial remuneration, the problem of what part of the entire fee available shall go to the surgeon is solved, and there need be no ignominy entailed upon anyone.

If this work achieves nothing beyond placing the relationship of the practitioner and the surgeon to each other and of both toward the patient, on a more equable and proper basis, the writer will feel that a worthy object has been attained.

The writer acknowledges most gratefully the assistance given him by Dr. John F. Connors, who has been concerned in much of the work necessary to make this book.

The house staff of the Harlem Hospital of New York, together with the nurses engaged there, have been of signal service in procuring the material depicted in many of the illustrations given. Their kindly offices are herewith gratefully acknowledged. Mr. I. Steinberg of this city gave valuable aid to the writer with respect to the art of photography, which has been considerably employed in the illustrations. This assistance is herewith acknowledged. The writer also wishes to commend the publishers for kindly assistance given, and thanks them for the skillful execution of their portion of this work.

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CHAPTER I

GENERAL CONSIDERATIONS

Cases in which operations are not urgent—Recording the history—Office arrangement—Bronchitis—Pulmonary tuberculosis—Tuberculosis of glands, bones, and other parts—Nephritis—Cardiac and arterial disease—Rheumatism and gout—Syphilis—Hemophilia—Alcohol—Tobacco—Morphin, Cocain, etc.—Obesity—Diabetes—Training of Tolerance for Manipulation of Cavities.

CASES IN WHICH OPERATIONS ARE NOT URGENT

The practitioner frequently sees cases presenting afflictions which require operative procedure for relief, but in which the condition will allow of previous systematic preparation. Not infrequently a careful taking of the history and a detailed general examination will discover complications which in no wise are consequential to the condition from which relief is sought, and which do not in any sense stand in a causative relationship to it.

If the operative measures are postponed until the coexisting pathological condition is remedied, or at least modified, so as to take from the surgical problem factors which may have a determining influence on the outcome of operative efforts at relief, the mortality rate of major operations will be reduced, and the period of postoperative disability much shortened. Also, patients may escape postoperative complications which might not have obtained had due consideration been shown the co-existing disease.

The conditions which are perhaps the most important factors worthy of consideration in this connection are taken up under a general head, as indicated in the title of this chapter.

Surgical operations have become so common a procedure and are now so universally employed for relief of affliction, that it is not improbable that the viewpoint of the profession has produced a dilution of conservatism which is to be deprecated. It is certain that the measures submitted here are wise and useful, and have been of signal service to those employing them.

RECORDING THE HISTORY

In well equipped institutions devoted to the care of the sick and injured, a systematic history of each patient is taken and a careful examination of the blood, urine, feces, etc., is made. The results of these examinations, together with the history, are recorded by the house staff, and as a rule form a valuable adjunct to the means at the disposition of the surgeon of arriving at a conclusion as to the diagnosis, and aid much in determining upon a method of surgical procedure indicated in a given case.

However, a patient admitted to an institution for the purpose of seeking relief by operation is not infrequently in a mental state which renders an accurate recital of the history a doubtful matter, yet the patient would be very apt to recite the facts more accurately to his physician, with whom he is likely to have been on terms of more or less intimacy.

Patients who are to be subjected to operation in their homes, or under conditions where the régime of a large hospital is not available, are entirely in the hands of their medical advisers, and the surgeon looks to them for full information as to the conditions which may influence his own actions.

It is not a laborious undertaking to inscribe a history of the case and file it in a convenient place for reference. The usefulness of such a measure will appear as the writer progresses with this work, but it is perhaps proper to suggest here a simple method by which the history of a case may be conveniently recorded and be readily available when needed.

A convenient method of making records for office use and for the purpose of guiding the surgeon is shown by the accompanying illustrations. There are many cabinets for the filing of card records in the market, purchasable at moderate cost. These cabinets may be located in a convenient place and the cards filed alphabetically. The writer uses three cards, a white one (Figs. 1 and 2) upon which the general history is written, a yellow one for the urine (Fig. 3), and a blue one (Fig. 4) for the pathological

Name Smith, Anna Date Jan. 2nd, 1908.

Residence No. 1 G----- Str.

Age 46 Sex F. Cond. M. Nat. U. S. Occup. Housewife

Family Hist. Father died of apoplexy at 45; mother died at 63, from Bright's disease.

Prev. Hist. Has had six children, the first at 21, the last at 36, all normal labors. Nursed all the children. Menopause two years ago. Had typhoid at 16, complicated by phlebitis of left thigh. Has had severe attacks of headache for last four years. Attacks last a day or two, then clear up. Two months ago noticed a lump in left breast, while bathing. Lump was not painful, felt hard and was about the size of an English walnut. When first noticed the lump could be freely moved. Paid no attention to it. Since

(Over)

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Fig. 1.—Front View of History Card with History.

then has noticed that skin became attached to the lump and that it had increased to the size of goose-egg. Has not lost flesh. Lump feels a little tender now. Examination shows a mass as described in outer upper quadrant of left breast. Nipple not retracted. Gland at outer edge of pect. major enlarged. No other gland palpable. Regarded as malignant, probably scirrhus. Advised excision of breast.

Jan. 12. Removed small section of mass. See report. Cephalic vein dilated, probably involvement of glands on axillary sheath.

Fig. 2.—Reverse Side of History Card. History Continued.

3

Name Smith, Anna. Date Jan. 3, 1908.

Quantity (24 hours) 48 oz. Specific Gravity 1010

Color Light amber Reaction Acid

Sediment Slight flocculent deposit.

Urea .021 gr. per c.c.

Indican Slight

Microscopic Examination A considerable number of granular and a few hyaline casts.

Albumin A small amount.

Sugar Negative.

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FIG. 3.—HISTORY CARD FOR RECORDING RESULT OF URINARY EXAMINATION.

Name Smith, Anna Date Jan. 4, 1908.

Pathological Report

(a) Blood Examination Shows simple anemia.

(b) Miscellaneous Matter (Sputum, Transudations, Specimens, etc.) Specimen from tumor of breast---scirrhus carcinoma.

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FIG. 4.—HISTORY CARD FOR RECORD OF PATHOLOGICAL REPORT.

record. The latter is an exceedingly useful one upon which may be added the microscopical findings of neoplasms, exudates, etc. On the reverse side of the blue card there is a place for a record of autopsy.

The cards suitable for a certain size of cabinet are readily obtained in the market, and may be printed either as indicated here or in a manner best suited to the method of the practitioner. In this way the effect of diet and medication is recorded, and when the time for operation arrives much valuable data is available.

It would be too cumbersome and unwieldy, to say nothing of the time used by a busy general practitioner, to expect that a complete history will be kept of every case of bronchitis or constipation which comes under observation. However, the plan offered or a similar one should be used in cases which demand operative relief, or in those which require repeated visits or examinations for the purpose of diagnosis.

For instance, the recording of the circumference of the neck in a case of goitre and subsequent measurements made from time to time will show the ratio of the increase in size of the growth and thus the element of error in this regard is avoided.

Farther than this, a systematic method of recording the history of cases tends to develop accuracy in the observation of details, an exceedingly important factor in differential diagnoses.

The illustrations show memoranda which record the history of a case of carcinoma of the breast. Figs. 1 and 2 (Fig. 2 is the reverse side of Fig. 1) show little of value in the accessory history, except perhaps that the father's death from apoplexy at the age of 45 might be regarded as arousing suspicion of inherited syphilis, this being, however, rendered negative by the fact that the patient had six healthy children. The headache carries out an accord with the urine analysis (Fig. 3). The fact that the cephalic vein became dilated soon after the first examination of the patient, would seem to justify the belief that considerable involvement of the glands about the axillary vein had occurred in the interim, which called for immediate, radical operative relief.

The urine analysis as reported (Fig. 3) is that of a small granular kidney and suggests general arterial disease. It also calls for the precautions taken up under these heads further on (page 15). There was nothing in the patient's history beyond the headaches mentioned which might have suggested the existence of nephritis, and indeed these might have been due to many other causes. However, the examination of the urine established a reasonable causative relationship. The bearing that discovery of the conditions mentioned has on the kind of narcotic to be administered at the operation, is also an important one.

The fact that nephritis exists would, too, determine the technic of the operation with the view of shortening the time over which the surgical manipulations were carried, if this were consistent with achieving the intent.

Fig. 4 shows the pathological report which, as already stated, is recorded on a blue card to facilitate ready identification when filed among a large number of histories. The blood examination need not be recorded in detail. The conclusion from the examination may simply be recorded as shown in the illustration. The simple anemia in this case shows that there may have been already some modification in general nutrition as the outcome of the presence of the affliction, though the body weight is not reduced and the appearance of the patient has not undergone any manifest change. The report of the microscopical examination shows the tumor to be a scirrhous carcinoma. In these cases the prognosis, as a rule, is not necessarily unfavorable. However, balancing this against the fact that the cephalic vein is dilated and that this means pressure on the axillary vein, the prognosis becomes less favorable, on the ground that the glandular involvement is probably considerable in extent and may have taken on a form of carcinomatous proliferation, the character of which is more malignant than that which obtained in the original focus of disease.

A complete history of this kind, though not carried out in great detail, makes quite possible a rational conception of the entire situation, and is invaluable to the attending physician, and especially to the surgeon who may not have an opportunity to elicit the facts thus furnished.

OFFICE ARRANGEMENT

The facility with which examinations are made and wounds cared for, is not a little enhanced by the apparatus and elasticity of its arrangement at the disposition of the practitioner. For the

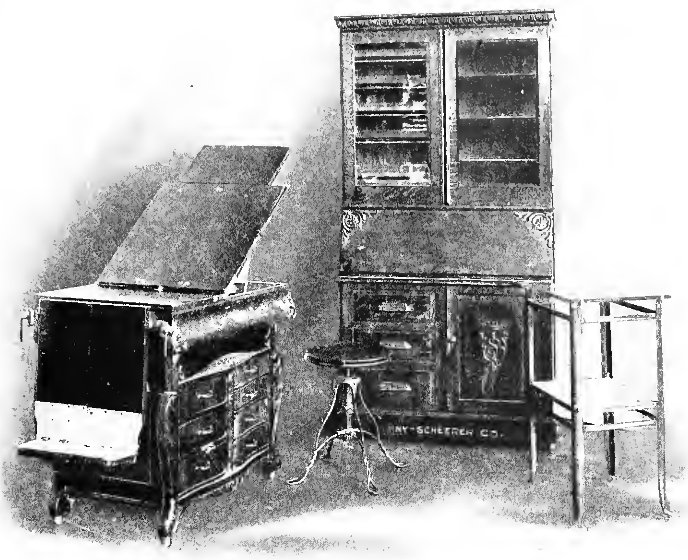


Fig. 5.—Office Equipment.

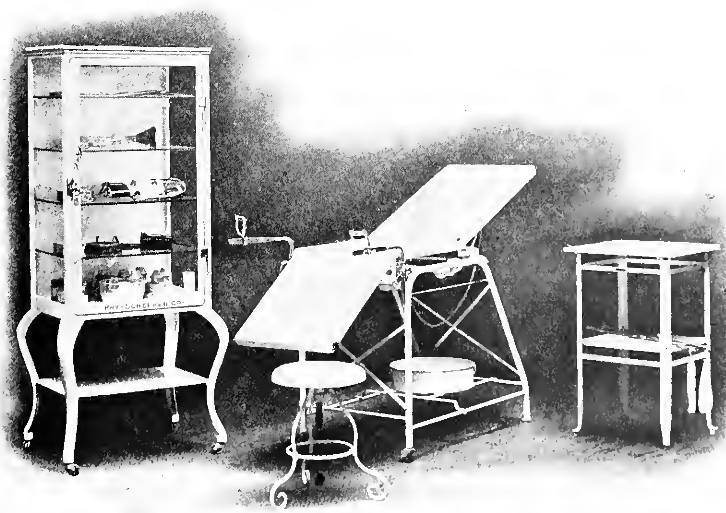


Fig. 6.—Office Equipment

general practitioner a suitable arrangement of examining table, instrument table, instrument closet, and chair is shown in Fig 5.

The appearance of the office is not altogether a question of scenic effect. As a rule, the display of awe-inspiring white enameled furnishings have an objectionable effect upon timid patients and the arrangement shown is less liable to provoke fear than if the furnishings were those of the enameled steel variety.

However, it is to be borne in mind that in the examination of genito-urinary cases and, indeed, in instances where lavage of surfaces or irrigation of cavities is necessary either as a part of an examination or in the after-treatment of operative cases, the enameled steel table with drainage is exceedingly valuable and is easily kept clean.

The arrangement in Fig. 6 shows an enameled outfit, which, however, is less desirable than the outfit shown in Fig. 7, which

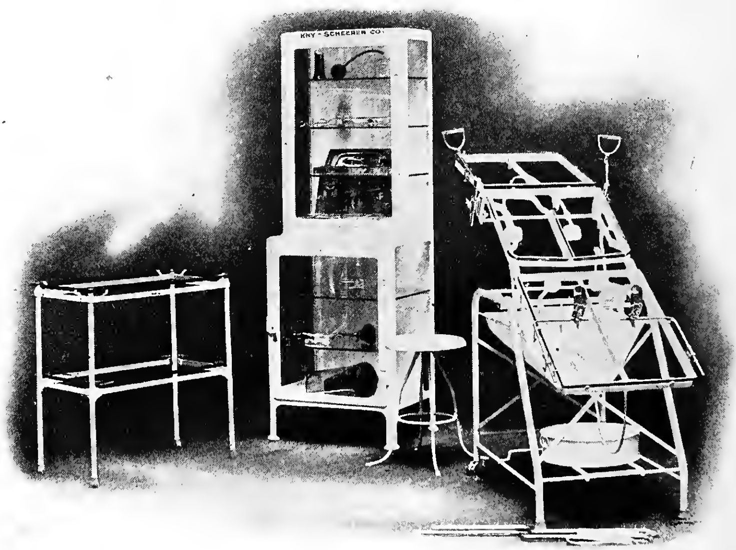


Fig. 7.—Office Equipment.

permits of drainage during the lavage of the perineum, etc. Between the outfits shown in Figs. 5 and 6 there is not much choice, except as far as the question of whether wooden or steel furnishings are used, except that the enameled outfit gives the impression of being more cleanly, which perhaps is only true as far as the table is concerned.

Of these three outfits Fig. 5 is recommended for the office of the general practitioner. Fig. 7 shows a more elaborate outfit suitable for the surgeon's office. The *Trendelenburg* posture is useful when small operations under local anesthesia are performed in the office.

In each instance it is best to have the examining chamber

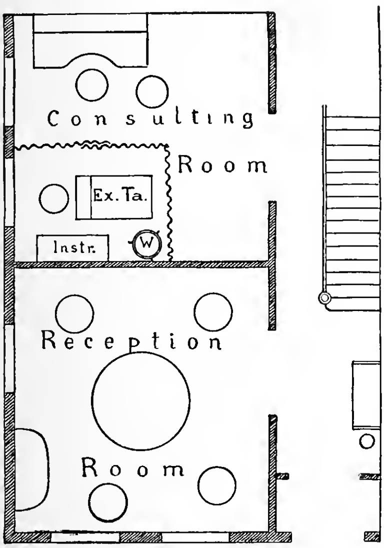


FIG. 8.—A SIMPLE FORM OF CONSULTING AND RECEPTION ROOM. The Examining table in the consulting room is placed conveniently to the light, which falls on the back of the operator as he sits at the foot of the table; this corner of the room is screened off. (*Kelly*.)

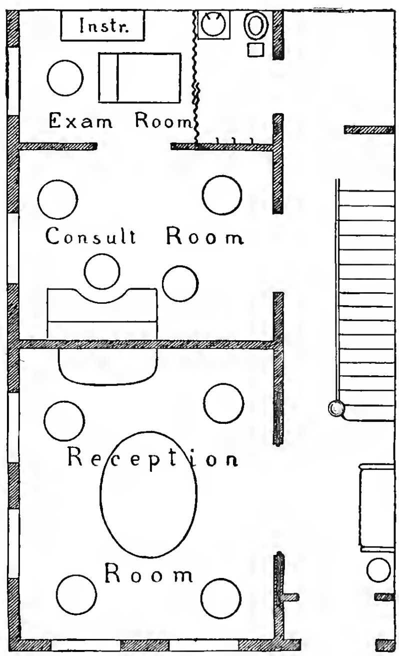


FIG. 9.—ARRANGEMENT OF EXAMINING ROOM SEPARATED FROM THE CONSULTING ROOM. The patient arranges the clothing behind the curtain indicated by the wavy lines. (*Kelly*.)

separate from the consulting room if this be feasible. In the event of this being impracticable, the outfit shown in Fig. 5 is perhaps the least liable to arouse annoyance in the minds of timid patients and will disturb less the symmetrical appearance of the practitioner's office, especially if he be compelled to spend much of his time there, using the chamber for other purposes.

Kelly suggests the arrangement of the practitioner's office as shown in Figs. 8 and 9. The arrangement in Fig. 8 may be employed when the available space is limited. A portion of the consulting room is used for the purpose, and the outfit shown in Fig. 5 may be arranged as shown. A more elaborate arrangement is shown in Fig. 9, including a reception room, a consulting room, and a separate examining room. The toilet arrangements in the examining room are placed at one end and behind curtains. The outfit shown in Fig. 7 can advantageously be used with this arrangement of space.

BRONCHITIS

Rollier considers the existence of bronchitis as a strongly predisposing condition favoring postoperative broncho-pneumonia. As the outcome of observation extending over many years he regards the administration of creosotol of signal benefit. The drug is given by mouth in doses reaching 1.00 mornings, and introduced into the rectum together with peptonized milk in doses of 2.00 at night.

The habits of life of the patient should be regulated with a view to overcoming the condition in the bronchi. If it be expedient a sojourn in a dry climate for several weeks before the operation should be indulged in. The excessive use of tobacco should be controlled, and if feasible, smoking should be entirely abstained from. During an attack of acute bronchitis, which may be regarded as infective in origin, no operation involving the administration of narcosis by the air passages should be undertaken.

In cases of chronic bronchitis, potassium iodid should be administered for a week before the operation and stopped twenty-four hours before beginning the narcosis, on the ground that the agent increases the secretion of the respiratory mucosa, an undesirable condition as regards the inhalation of narcotics. It is best to furnish the patient with a saturated solution of potassium iodid, of which he is instructed to drop five drops into a half tumbler of water to be taken three times daily after eating. The dose is increased three drops a day until slight iodism is produced. If the time set for the operation arrives before iodism is established the agent is withdrawn, as indicated above. If sharp iodism occurs just before the time set for the operation, a postponement of the surgical procedure for twenty-four hours is desirable. In case iodism occurs a week before the operation, the drug is withdrawn for a day and again administered in doses of half the quantity taken at the time iodism occurred, and this dose is maintained to within twenty-four hours before the beginning of the operation.

PULMONARY TUBERCULOSIS

Patients suffering from advanced pulmonary tuberculosis are exceedingly unfavorable subjects for operation. However, persons with a slight or moderate invasion of the lung by a tuberculous process should not be deprived of the opportunity for relief from afflictions susceptible of relief by surgical intervention.

The exhausting effect of malignant disease, or perchance urinary calculus, should not be permitted to go on because of an existing pulmonary tuberculosis. It should be mentioned in this connection that pulmonary tuberculosis of itself is not a necessarily fatal disease, and that under proper care and management recovery takes place in a not inconsiderable number of cases. The chief factor to bear in mind is that the addition of mixed infection is usually the determining causative factor productive of a fatal outcome. In cases of lung tuberculosis where operation is necessary, beyond the usual treatment of over feeding, additional precautions should be taken to prevent the occurrence of an added infection of the lung, chiefly of the class which is generally designated under the head of " Grippe."

Patients thus afflicted should be carefully protected from exposures on the ground that additional tax upon the heat unit creators may be avoided. The indiscriminate employment of the so-called fresh air treatment should be avoided. It is difficult to see how placing a patient, suffering from pulmonary tuberculosis, on a fire-escape and allowing the chill night air to extract his calories, is going to be of aid in combating the invasion of an exhausting infection. It is probable that a well ventilated room is less apt to be the habitat of pathogenic bacteria than one not so treated. However, the general medical laws of reason and judgment must not be disregarded in favor of a fad which, to say the least, is not founded on generally accepted physiological facts.

There are two general factors which render patients suffering from pulmonary tuberculosis unfavorable subjects for operation. One is the exhausting effect of the operation itself and the other the pernicious effects which the administration of a narcotic by the respiratory tract has directly upon the lung tissue. In a general way, the latter is perhaps the more important determining factor.

With regard to the former, the patient should be fed along the lines now so generally understood as to need no prolonged discussion here. Eggs, milk, meat, and these in frequently repeated doses, should be given. The over-feeding should be maintained until within five hours of the operation and the starvation period curtailed as much as possible.

Rectal feeding should be begun immediately after the operation, indeed before the patient leaves the operating table, and the various measures destined to allow of early nourishing carefully observed (page 287).

Creosote should be given by the mouth for a week or more before the operation, preferably in a keratin coated pill, to obviate gastric disturbances, and the patient should be ordered to inhale vaporized creosote for several hours daily with the view of rendering less liable the occurrence of a complicating infection of the lung, rather than because it is believed that these measures will benefit the tuberculous process in the lung itself.

Various forms of vaporizers are on the market, any one of which will serve the purpose. In the event of none of these being available, the creosote may be mixed with alcohol and dropped on a sponge fastened in the apex of a tin funnel and then held before the nose and mouth.

Too often does the surgeon see cases of latent pulmonary tuberculosis develop an acute exacerbation after a surgical operation, which carries off the patient in a short time. How often this will be avoided by taking the extra precautions here mentioned, it is, of course, difficult to say. However, the physician who gets his case ready for the surgeon might well consider the proposition from this aspect and perhaps avoid unfavorable outcome as the result.

TUBERCULOSIS OF GLANDS, BONES, AND OTHER PARTS

Tuberculosis of glands, bones, and other parts should be handled along the same lines as indicated in connection with lung tuberculosis, though the added danger of the baneful effect of the narcotic on the lung tissue does not enter as a factor here. The special precautions to be taken with a view to rendering the surface of the body asceptic when operation is undertaken for bone tuberculosis which has broken down, will be taken up with skin sterilization (page 51).

NEPHRITIS

Albuminuria does not necessarily mean kidney lesion. The presence of casts may mean kidney disease, but the kind of kidney disease and perhaps its extent are determined by a complete chemical, quantitative, qualitative, and careful microscopical examination of the urine. It is not improbable that the evidence of the clinical significance of kidney lesion is to an extent standardizable by the condition of the heart, blood vessels, and the liver. The simple presence of albumin in the urine does not call for especial measures of treatment.

Kidney disease without manifest arterial and cardiac disease calls for special precautions during the period of preparation for operation. Alcohol should be absolutely avoided, bearing in mind, however, the precautions in this regard taken up under alcohol (page 23). It may be said here that the tendency toward radicalism in this connection is perhaps more justified than obtains when nephritis does not exist. The additional tax upon the kidney parenchyma in eliminating alcohol seems to justify this.

The aim of the physician should be to render as light as possible the labor of the kidney, in the separation and elimination of the end products of metabolism. It is generally believed that the kidney is most largely concerned in eliminating the end products of proteid waste and digestion. The diet, therefore, should contain the least quantity of organic nitrogenized constituents consistent with the general health. Meats and eggs are to be avoided. The proteids exist in most starchy foods, and probably in sufficient quantity to avoid error in nutrition which might occur as the result of their entire withdrawal. A purely milk diet would be, logically, of perhaps the most service in this connection, milk containing comparatively small quantities of nitrogen. However, some license should be given the patient and white chicken meat and fish allowed once daily.

Large quantities of water should be partaken of. It is not improbable that the washing of the kidney in this way is serviceable, on the theory that the effort on the part of the cell lies along the lines of converting an end product of metabolism from alkaline medium into an acid excretion. It would seem probable that the urea and other soluble constituents of the urine are mechanically washed out of the kidney in this way.

The kidney, however, is not the only organ concerned in eliminating the end products of metabolism. The skin and intestines are important eliminating organs, and the labor of the kidney may be greatly lightened by using these vicarious channels of elimination during the period of preparation for operation. The administration of pilocarpine, steam baths, and the maintenance of the body at a temperature at which the skin acts freely, are useful measures.

Catharsis and colic lavage are to be used freely. The former is perhaps well achieved by the administration of sodium phosphate in hot water before breakfast, and the latter employed at night, using a quart or more of normal saline solution for the purpose. If the nephritis be a part of general arterial and cardiac disease, a judicious mingling of the rules laid down in each particular class of cases is to be employed. The proteids should be increased to lessen the work of the digestive organs and a daily examination of the urine made to act as a guide for the variations in amount of these articles of diet. Although this detail is somewhat laborious, it is well to bear in mind that the condition of the patient at the time of the operation in this regard is an exceedingly important and perhaps determining factor. The conservation of a diseased organ like the kidney may place it in a position to take care of the end products of ferments entering the circulation as the outcome of reparative process, and even in cases where infection does not take place the presence or absence of these bodies in the blood may be regarded as a predisposing factor toward infection.

The physician should give the patient a written set of orders each evening to govern the diet, amount of water to be taken, time and length of steam bath, temperature of the room, and the character and quantity of clothing to be worn in the house and when in the open air.

The conclusions in these regards, the physician arrives at as the result of the analysis of the urine made that day, and the variations in the quantitative analyses shown as the outcome of the régime of the day before. It is true that persons afflicted with kidney lesions would demur at this radicalism if it were extended over a prolonged period of time, and perhaps, too, the fact that diseased kidneys frequently seem to have no determining influence on the general health of patients would seem to make the effort unnecessary. However, during the period of preparation for operation, the writer regards the measures indicated as essential and admonishes the physician to see to their execution.

Again, the evident concern for the patient and the manifest interest evinced by the practitioner in the effort for a successful outcome of the operation, will place the physician in a more desirable position both with the patient and his colleague, the surgeon.

It is not infrequently the experience of the surgeon to have sent to him for immediate operation a case which has to be delayed while the preparations stated are made. This involves an ignominy to the physician which should be avoided.

CARDIAC AND ARTERIAL DISEASES

These conditions are so closely allied and so frequently coexist that they may be considered together.

In preparing for operation patients who suffer from either or both of these conditions, the aim of the attendant must be to lessen the labor which these organs are called upon to perform, rather than to attempt radical curative measures. Cardiac valvular disease with compensatory hypertrophy of heart muscle, the outcome of previous endocarditis of rheumatic origin or the sequel of an acute infectious disease, does not call for special measures beyond resting the heart muscle as much as possible and giving the patient a diet which will tax as little as is possible the circulation during digestion.

The indiscriminate administration of cardiac stimulants such as digitalis is to be avoided. The pulse rate during rest and after exertion should be carefully noted, and efforts allowed within the range indicated.

If there be compensatory hypertrophy, the heart should not be expected to do additional work during the period of preparation for operation, though absolute confinement to bed might, on the other hand, have a sufficiently depressing effect upon the patient to over-balance the beneficial effect of the conservation of the vital forces by absolute rest.

The handling of these cases requires some tact and considerable ingenuity. Most practitioners would regard systematic exercise as a valuable aid in bringing the patient's general tone to its most useful level. However, in cases of cardiac valvular disease the form of exercise should be modified so as to stop short of giving rise to dyspnea.

Many laymen have the notion that exercise in the form of golf or horse-back riding, and the like, would be of service in rendering them better fitted to withstand a severe strain of the so-called vital forces. In most instances this is true, but if the physician discovers a heart lesion during the preliminary examination it is his duty to acquaint the patient with the conditions and advise modification of mode of life consistent with the facts presented.

The taking of nourishment is influenced, both as regards quantity and character by the mental state of the patient, and if it be apparent that the restrictions with respect to exercise are the cause of apprehension or mental depression, which interferes with nutrition, a drive in the open air or a daily walk at the rate of two miles an hour should be allowed, both of these to be so timed that the usual meal is taken soon after a period of rest, which should follow the exertion. Fifteen to thirty minutes of rest is sufficient for the purpose.

Unnecessary exertion during digestion should be avoided. The picture presented by the engorged lacteals and veins of the mesentery concerned in extracting from the digestive tract the nutritive constituents of articles of diet, during digestion, when animals are subjected to celiotomy at this period, is a strong appeal in favor of conserving the energies of the patient in this class of cases. The circulation, of which the heart is the chief *vis a tergo* should not be additionally taxed as the result of physical exertion at this time.

It is perhaps proper, in this connection, to call attention to the fact that the human animal is the only one which voluntarily engages in physical exertion immediately after eating. All of the lower animals repose during digestion, a teleological example it would be well for the physician to have his patient emulate, especially in instances where the circulatory organs have undergone pathological changes.

In this class of cases, too, the diet should consist largely of proteids, which leave comparatively little residue after the nutritive constituents of articles of diet have been extracted from the ingesta, and which do not severely tax the organs concerned in furnishing the necessary ferments to the digestive tract, occupied in converting into glucose the carbohydrates, or of emulsifying the fats into readily absorbable form.

This, of course, does not apply to the class of cases in which nephritis exists as a part of a general arterial disease. However, the question of administering the proteids in cases of nephritis is taken up under that head (page 13).

If the heart fiber be sufficiently impaired to justify the use of artificial stimulation, a careful record of the medication administered should be kept, and this should form the basis of the conduct of the case during, and immediately after, the operation. Then, too, the technic of the actual operation may be varied in order to meet the indications during the procedure, if cognizance be taken of the degree and character of stimulation employed in a given case. For instance, a careful repair by sewing of the layers of the broad ligament after pan-hysterectomy might be omitted as a refinement in technic which is not essential to the consummation of the intent of the operation, if the symptoms presented by the patient indicate that the artificial tone of the heart fiber, the outcome of stimulation, is giving evidence of feebleness. Indeed, a knowledge of the exact conditions in this regard may decide the surgeon's technic in a given case and cause him to abandon the more complex method of procedure for one less desirable but perhaps equally effective, as far as relief is concerned, when all the conditions are taken into account.

A simple test with regard to the tone of the cardiac muscle fiber is one suggested by *Katzenstein*. Both external iliac arteries are compressed for from two to five minutes. The normal heart does not accelerate its action under these conditions, but if there be cardiac insufficiency the pulse rate becomes perceptibly increased. If the heart muscle is insufficient, the blood pressure is lowered, if no insufficiency exists it rises. *Kocher* advises the use of the Riva-Rocci apparatus to determine the blood pressure.

In cases of varicose condition of the veins of the lower extremities the danger of thrombi and embolism should be borne in mind. An elastic stocking should be worn during the day and the legs elevated while the patient assumes the recumbent position, measures which should be employed for several weeks before the operation.

RHEUMATISM AND GOUT

Beyond the endocardial and endarterial changes caused by these afflictions the employment of special measures is called for when patients thus afflicted are about to be subjected to operation. The reduction of resistance accompanying all operative procedures is liable to precipitate an outburst of rheumatic inflammation of the various serous membranes of the body. It is not uncommon for persons afflicted with the so-called rheumatic or gouty diathesis to have an attack of " rheumatic fever " immediately after a major operation.

Persons afflicted in this way who are about to be subjected to operation should be given much the same preparation as for nephritis (page 13). Beyond this, the salicylates and colchicum should be given for a week or more preceding the operation. A useful method is to combine asperin in doses of ten grains with colchicin, which are administered three times daily after eating. Of course, a surgical operation during an acute attack of either rheumatism or gout is only justifiable in the event of the occurrence of some grave condition which would justify the measure despite the added dangers as the result of the complication.

In the subacute or latent forms of the diseases it is well to combine small doses of iodid of potassium with the salicylates and colchicum. The dose of iodid of potassium need not exceed five grains three times daily. When the three agents are given together they should be administered in solution, and well diluted, perhaps best in an alkaline water and taken during digestion.

These precautions need not be limited to cases which present more or less indefinite manifestations at the time the operation is decided upon. If it appear in the history of the case that the patient has had rheumatism or gout, and especially if he be past the meridian of life, it is wise to take measures of safety.

The writer recalls a case of irreducible hernia which had become inflamed. The patient, a man of fifty-five, was subjected to herniotomy, which was successfully done. At the end of a week meningitis developed, which, in view of the simultaneous involvement of several of the joints, was regarded as of rheumatic origin. Caffeine salycilate was given hypodermically, together with other anti-rheumatic treatment, and the patient ultimately recovered. Later it was ascertained that he had had two attacks of acute articular rheumatism during the ten years before, and had had various more or less indefinite manifestations since that time. It has been the writer's custom to use the precautions referred to in cases to be operated upon which present a rheumatic or gouty history, and to follow the operation with an enema containing a drachm of sodium salycilate, which may be combined very readily with other nutritive or remedial agents indicated at the time for other reasons.

In cases of this sort an endocarditis is an exceedingly menacing complication and should be given due consideration in instances in which cardiac symptoms are manifest, which are not in accord with the other symptoms, which may be properly regarded as logically consequential to surgical trauma. This is also true with respect to pleurisy. It is not uncommon to have patients who have been subjected to operation develop pleurisy several days after the operation. This has been ascribed to exposure to cold, the narcotic used, and various other causes. In a not inconsiderable number of cases, close questioning will reveal a history of a previous attack of rheumatism, and the diagnosis clears up.

In most instances, when the pain and dyspnea first appear, the attendant immediately thinks of a septic embolus and sees visions of suppurative pneumonia, empyema, general sepsis, and death. Of course the examination of the blood and the absence of the characteristic febrile movement of sepsis contribute much to making clear the diagnosis. However, if it be known that the patient has already had rheumatism, the case is more readily treated and a reasonable assurance of recovery may be given. The simultaneous involvement of the serosa of a joint or several joints may lead to a correct conception of the condition presented, but this, too, may lead the attendant to arrive at the fallacious conclusion that he is confronted with a case of general sepsis with pyemic metastases.

SYPHILIS

During the more or less acute manifestations of the secondary stage, or during the time of the presence of the lesion corresponding to the port of entrance of the infection and the secondary manifestation, may be regarded as a contra-indication to operation, unless the indication for measures of relief by surgical procedure are imperative and necessary to recovery. The double reason for this lies in the fact that the surgical trauma would not readily repair and, too, because of the danger of communicating the disease to the operator and assistants.

If emergency arises during the periods of the disease mentioned the operation should be preceded by thoroughly mercuriarizing the patient immediately before and after the operation. This is best done by intramuscular injections of mercury, either gray oil (*Fournier*) or some one of the preparations of mercuric salicylate, bichlorid or cyanid now on the market.

The operator and assistants should take especial precautions to avoid contamination and the operation be carried on under antisepsis rather than asepsis.

Irrigation of the operative wound with bichlorid solution during the procedure seems a rational indulgence, bearing in mind, of course, that serous membranes are exceedingly subject to chemical irritation and that solutions of moderate strength should be used in the peritoneum and on joint surfaces. In wounds of the extremities and, indeed, in bone trauma the tolerance for mercury is considerable. If the case be one which gives a history of syphilis of long standing and the operation be not imperatively indicated, the administration of anti-syphilitic medication may be given by the mouth, taking the precautions with regard to salivation and gastro-intestinal disturbances usually employed.

It is not to be assumed that because a case has had no manifestations for several years that the problem may be disregarded. On the contrary, cases of syphilis which have apparently completely recovered will burst out into distinct syphilitic manifestations a few days after operation. Theoretically it may be justifiable to assume that the disease has been under control and that the lessened resistance, which is the outcome of the operation, has permitted of an outburst. The writer may, in this connection, quote a case of a woman of twenty-eight who was subjected to cholecystectomy for colelithaisis. On the third day after the operation a widely spread skin lesion developed, which, after careful inquiry respecting the husband's and her own history, was determined to be syphilitic. The eruption cleared up very readily under appropriate anti-syphilitic treatment, not until, however, a small ulceration of the tongue appeared. The latter was scraped and the presence of the spirocheta pallida demonstrated.

It has happened in the experience of most surgeons that wounds which have shown no evidence of infection are sluggish, do not heal, and the stitches cut through leave a pale open surface but sparsely covered with flabby granulations. These cases, if they be not tuberculous, will usually heal very readily if anti-syphilitic medication be administered, and the attendant faces the annoyance of the conviction that, had his patient been subjected to the precautionary measures indicated, this might have been avoided.

Wounds which do not heal promptly and are regarded as retarded by the syphilitic condition should be frequently cleansed with solutions of corrosive sublimate, and after the lavage the wound and contiguous skin dried, using ether for the purpose, and the surface of the traumatised part covered with the ordinary mercurial ointment.

At each dressing the residual ointment is removed with ether, the wound lavaged with corrosive sublimate solution, and again covered with the ointment. This should be repeated every two days, and will be found to cause healing to take place quite rapidly.

HEMOPHILIA

Hemophilia is an affliction which is probably attended with some abnormality in the structure of the blood vessels which renders them more liable to rupture, in addition to the absence, or at least modification, of the so-called fibrin ferment in the blood.

If the peculiar diathesis be recognized before surgical trauma is inflicted, early measures should be taken to increase the patient's general condition, with a view to improving the arterial tone. How much exercise and proper nourishment will contribute to this, it is, of course, difficult to say. However, an effort in this direction should be made and a régime initiated with this in view. Bleeders should never be subjected to operative procedure, except when it would appear that the risks are justified in making the effort, in view of the character of the affliction for which the operation is undertaken. Considerable effort has been made to modify the conditions by administering in these cases various substances, with a view to increasing the coagulability of the blood, at least for a sufficient period of time to permit of operative work and subsequent healing. Most of these, like ergot and lead acetate, have proven of little value.

Thyroid extract seems to have been of considerable service. *Fuller* and *Taylor* report successful results in operations on bleeders in which this agent has been administered before and after the operation. *Taylor's* work would seem to show that normal blood is not influenced as regards coagulability by the extract, and that it acts upon the blood of the bleeder which seems to be deficient in so-called fibrin ferment.

In suspected or recognized hemophilia, if feasible, the blood should be tested and the time required for coagulation noted. The extract is then administered in doses of from three to five grains three times daily after eating, and at the end of forty-eight hours the blood again tested, when a diminution of time required for coagulation to take place should show an increased rapidity of 50 per cent.

The tests are cumbersome and difficult to manage. *Taylor* used *Wright's* method.

It is, of course, not feasible to subject cases of hemophilia to the proper chemical test required to prove the efficiency of the thyroid extract, in each instance, especially as the practitioner is not in a position to make the necessary test, because of lack of particular training in this department. However, it would seem to be proper to administer the agent in cases of hemophilia, without recourse to the test in a given instance, accepting, as indeed we all do, the outcome of the investigations of reputable laboratory workers.

Thyroid extract is liable to give rise to cardiac disturbances, and the dosage should be regulated in accord with the manifestations in this regard. The administration of the extract need not extend over a longer period of time than is included in a week before and a week after the operation.

In cases of jaundice and allied conditions which favor persistence of bleeding following surgical trauma, the extract has been found of service in controlling the hemorrhage. (See Obesity, page 31).

Calcium Chlorid has been used for the purpose, eighty grains being administered in divided doses daily for two days before the operation. The *Mayos* have used this agent in cases of severe jaundice. They do not regard the time tests of the coagulability of the blood as reliable.

Gelatin. Hare recommends the administration of gelatin to control the hemorrhage, using the following formula for the purpose:

Gelatin	
Sodii Chlorid.............	aa 10.0
Aquæ dest.................	1,000 c.c.

The mixture is sterilized by heat and 60 c.c. are injected into the buttock. This is increased to 120 c.c. if repetition is necessary. Usually two injections are used. Gelatin has been used more largely to control oozing after operation. It might be rational to use the thyroid extract as a preparatory measure, and, if oozing occur after the operation the gelatin injections may be used. *Hare* regards the mixture of use applied locally to check oozing.

ALCOHOL

There can be no doubt that from a scientific standpoint the human animal is better off without the use of alcohol in any form. It is also probably true that the moderate use of alcohol does no great harm. It is exceedingly probable that the use of grape alcohol is less harmful than that of grain alcohol. It is, however, also true that the vast majority of people use alcohol to varying extent and in varying amounts. The physician is confronted by a clinical fact.

It is not the purpose of the writer to enter into the discussion of the place alcohol occupies in the treatment of wasting diseases or prolonged febrile movement, as a discussion of this sort does not belong here. It is, however, proper that the matter be taken up in its connection with the preparation of chronic alcoholics for severe operations.

If *Bunge* is right that a normal individual weighing 140 pounds can oxidize two ounces of alcohol in twenty-four hours, almost the entire human race may be regarded as chronic alcoholics, for most men take more than two ounces of alcohol in the day. Two ounces of alcohol is equivalent to four ounces of brandy, and about the same or a little greater amount of whisky. Most Americans take an ounce and a half of whisky at a drink. If three drinks of whisky in the day be the basis of what may be regarded as not excessive, one gets a pretty good standard for a working basis. It is a simple matter to apply this to wines and beers. Average amount of alcohol in brandy, 50 per cent.; whisky, 40 per cent.; beer, 4 per cent.; claret, 8 per cent.; white wine, 10 per cent.; champagne, 10 per cent.

Given a man of forty-five or more who has habitually taken a whisky and soda with his lunch, a cocktail or two before dinner and a light wine with his dinner, and possibly the equivalent of two drinks of whisky during the evening, one must regard him as a chronic alcoholic, and he undoubtedly is. If this man is deprived of alcohol as a matter of policy he probably would not regard himself subjected to great hardship, and, beyond a more or less indefinite discomfort together with a certain irritability of temper which he does not associate with the real cause, no symptoms would develop. But let the conditions arise making necessary a severe surgical operation, and the symptoms arising from the withdrawal of alcohol, added to the natural feeling of apprehension attendant upon the contemplation of a severe ordeal and the withdrawal of alcohol, become a question of considerable moment.

The physician has no right to act the part of the social reformer in this class of cases. The mental state of a patient about to be subjected to a severe surgical operation is at best a much disturbed one. The symptoms attendant upon the withdrawal of alcohol are closely allied to the natural state of mind of the patient, *i.e.,* irritability, insomnia, and apprehension out of proportion to the conditions presented, and this should be avoided if feasible. It is wiser for the physician to take charge of the administration of alcohol himself, adjusting the quantity and character of the beverage to meet the indications.

It is not sufficient to lay down a general rule in this regard. Inquiry should be made as to the patient's habits, and if he is made to understand that the detail is entered into for scientific reasons, and that no humiliation is involved to him, the occurrence of dangerous complications after operative procedure, the outcome of deceit or false timidity may be avoided.

If there be sufficient time between the making of the diagnosis and the operation, an effort should be made to have the patient entirely free from the use of alcohol at the time of the operation, but if this be not feasible, as shown by the symptoms presented, alcohol should be given up to the day of the operation, and if necessary introduced into the rectum together with other remedial agents in a manner which will be taken up under the head of rectal alimentation.

Patients possessed of naturally great firmness of character, but who use alcohol as the result of congeniality, a part of a metropolitan life, are apt to take it upon themselves to suddenly stop the use of alcohol because of the general instructions given by the physician that alcohol is inimical to health. This sacrifice should not be blindly encouraged. The patient himself is not in position to judge of the matter.

Careful inquiry should be made in this connection and the patient advised just how much alcohol and in what form it should be taken. The patient then considers the use of alcohol as a medication, and its proper and physiological use will not be regarded as intended to produce an artificial complacency during a severe trial of fortitude, a proposition a well-balanced man is likely to shrink from, perchance to his own detriment. In these cases it is best to reduce the amount of alcohol to two ounces in twenty-four hours and control the increase or decrease of dosage as meets the indications.

If brandy or whisky is used it should be largely diluted. The salts in vichy water and similar waters separate the small quantity of resin in distilled beverages, and it is best to use carbonated or still plain water as a diluent. In persons who use large quantities of alcohol a more stringent policy should be pursued.

It has been the experience of all surgeons to see delirium tremens, and, indeed, meningitis alcoholica, develop after operation on patients whom the surgeon had had no idea were alcoholic. Had this been taken into consideration and the case treated along the lines stated above, this might have been avoided. Among postoperative complications which are in no wise consequential to the procedure, may be included pneumonitis and infection of the superficial wound; more rarely infection of the deep wound. Both these may be regarded as the result of lessened resistance, in part the outcome of the complete withdrawal of alcohol.

When a patient who consumes large quantities of alcohol is about to be subjected to operative procedure he should be placed under the care of a competent nurse for several days, and, if feasible, for a week. Alcohol should be given as indicated above, and this supplemented with the bromides and chloral at night and systematic exercise and bathing during the day. It should not require more than a week to reduce the quantity of alcohol necessary to prevent manifestation dependent upon its withdrawal.

The diet should be light and nutritious, consisting mainly of eggs, milk, lean meat, stale bread, and fresh vegetables. An excessive amount of carbohydrates should be avoided on the ground that the glycogenic function of the liver should not be severely taxed, having been concerned in wrestling with the end product of this class of substance for so long a period of time. All the eliminatory organs should be used with a view to lessening the burden of metabolism, the skin, the kidneys, and the intestinal canal. This is readily accomplished by steam baths, massage, the drinking of large quantities of water, and lavage of the colon.

In advising the use of these measures, the physician must state to the patient the hour at which the steam bath is to be taken, the quantity of water to be partaken of in twenty-four hours, and the time at which the colic lavage should be made. The time the patient is to be in the steam bath should be advised; the kind of steam bath also.

If it be convenient of course the public Turkish bath may be used, but, if this be not feasible for any reason, one of the apparatuses on the market may be employed in the patient's house.

It is probable that about fifty ounces of water should be taken, beginning with a glass of hot water before breakfast. This should have a pinch of salt added to it. Most men are habituated to emptying the bowel immediately after breakfast, and this time should be devoted to the colic lavage. The steam bath, and subsequent massage should be given at five o'clock in the afternoon, preferably after the patient has taken a walk or drive in the open air. He should be permitted to lie down for an hour after the bath, but should not be encouraged to sleep, so that he might not become wakeful after dinner.

The time could be well taken up with perusal of light and amusing literature. After dinner it is best to allow the patient to play cards or attend some place of amusement if the conditions permit. Cheerful surroundings are a valuable adjunct in these cases. If insomnia occurs recourse to hypnotics need not be taken at once. If feasible, an attendant or member of the family should stay in the room with the patient, and after he has retired read to him or engage him in conversation on any subject other than his health or the "curse of rum." Under no circumstances should the patient be allowed to go to bed with the room darkened and morgue-like silence maintained. The notion that the patient can force himself to sleep is a fallacy. On the contrary, as soon as it is manifest that the patient is restless and irritable, his attention should be engaged in other matters and ultimately a hypnotic administered as a last resort, if these measures fail in their purpose.

As to the mode of administration of alcohol, a light wine taken with meals is of course the least harmful method of use. However, much will depend upon the previous habits of the patient. It is a singular fact that grain alcohol drinkers have a repugnance for grape alcohol, and if grape alcohol be given a grain alcohol drinker, he will get its physiological effects and regard himself as cured of his alcoholic appetite because he no longer needs grain alcohol. All alcoholic beverages should be given well diluted and during gastric digestion.

Alcohol should not be given before meals for obvious reasons, but it is to be borne in mind that the aim in the class of cases under consideration is to place the patient under the most favorable possible conditions to withstand a surgical operation, and if the withholding of alcohol at times to which the patient is habituated is going to increase the symptoms related above, a fair compromise would be to allow the administration of alcohol before meals, well diluted and together with an "apertiff," like anchovy or caviar.

If the operation becomes necessary before the patient is entirely weaned from the use of alcohol, or if an operation becomes imperative in a patient who is alcoholic, alcohol should not be given by the mouth for five to six hours before the operation. In these cases an enema consisting of eight ounces of peptonized milk (cold process), forty grains of sodium bromid, and thirty grains of chloral hydrate, together with two ounces of brandy, should be administered two hours before the operation, and this should be repeated three hours after the operation, the latter to be again repeated in case vomiting be a marked after effect and oral administration of alcohol thus made impossible.

The subsequent administration and dosage of alcohol are controlled by the symptoms manifested later on. As a rule, alcohol will not be indicated for more than three days after the operation, and indeed it is observed in hospital practice that patients who were markedly alcoholic at the time of admission to the hospital convalesce and recover without the need of alcohol, if the the case has been rationally treated during the period of time mentioned.

TOBACCO

Much of what has been said of alcohol may be applied to tobacco. While a discussion regarding alcohol is not strictly limitable to the male sex, it may be said that women, as a rule, are not alcoholics and still less users of tobacco. It is, however, true that most male adults use tobacco in some form. Most commonly the tobacco is smoked.

Here, again, no discussion of the moral or pathological effect of the use of tobacco will be entered into. It is sufficient to assume that the patient smokes or uses tobacco, and to consider what influence indulgence of the sort has on the mental and physical condition of the patient in its bearing on an imminent operative procedure.

It may be said that tobacco has a disturbing influence on the circulation, giving rise to what is known as the tobacco heart. Whether this is the outcome of an effect on the cardiac centers or on the muscle fiber of the heart itself makes no difference as far as its bearing in these cases is concerned. It is to be borne in mind that withdrawal of tobacco is accompanied by tumultuous heart action together with certain symptoms associated with functional disturbances of the nervous system, such as restlessness, apprehension, irritability, and insomnia, much the same group of symptoms applying to alcohol. Here, again, the attendant must exercise rational judgment in advising the patient, bearing in mind that it is best to have the patient entirely free from the use of tobacco at the time of the operation, but if this be not feasible without great hardship to the patient, conservatism should be exercised and tobacco allowed in sufficient quantity to control the symptoms.

A mild Turkish tobacco or a carefully "cured" American tobacco should be used. However, if the patient be habituated to the flavor of Havana tobacco, and it appear that he craves for the subduing effect of this particular brand, it should be allowed in as moderate a quantity as possible. It is confusing to the surgeon to standardize the import of pulse rate in patients who have the tachycardia, which is the outcome of the sudden withdrawal of tobacco, and this should be taken into consideration in arriving at a conclusion as to the significance of circulatory disturbances during operations, which may be fallaciously ascribed to impending shock or to overdose of narcotic. The anesthetist, too, would have one disturbing factor removed if conversant with the conditions in this regard.

During the after-treatment of a surgical case this is a consideration of some import. More especially if there be a disproportion in pulse rate to number of respirations, and if the possibility of this being the outcome of the withdrawal of tobacco be not taken into account it might be erroneously considered as indicative of infection.

During convalescence the bearing which the use of tobacco may have on quick recovery is not a minor factor. There can be no doubt that reaction from severe surgical operations is to some extent, at least, influenced by the mental status of the patient, and if a man of sixty who has had an amputation done for gangrene of the leg is permitted to sit on a veranda and smoke, he will convalesce more rapidly, provided he has been habituated to the use of tobacco. It is difficult to see how smoking can possibly have any effect upon the genesis of reparative processes, but if the general wide principle be borne in mind that the elements from which the cell makes its component parts are derived from the ingesta which enters the gastro-intestinal canal, and that patients will take more nourishment under the conditions mentioned, we have the rationale of the proposition made clear.

MORPHIN, COCAIN, ETC.

Morphinism and the use of allied substances is not widely distributed, yet is sufficiently frequent a condition to be taken into consideration.

Patients who use narcotics or anodynes are not good subjects for operative manipulation. However, surgical interference at times becomes necessary with this class of patients, and the conditions must be given due consideration. The physician has here to deal with a more grave and more distinctly determining complication than obtains with either alcohol or tobacco.

Patients habituated to the use of opium or other narcotics and anodynes require prolonged treatment to effect a cure, and present more acute symptoms when the drug is withdrawn than obtains with the agents mentioned.

Much depends upon the quantity taken daily and the reason for the indulgence. If the drug be taken to relieve pain, the result of the condition for which the operation is undertaken, the drug need not be withdrawn and only controlled as to amount and perhaps mode of administration, the relief of the affliction by the operative measure, rendering permanent withdrawal of the drug a comparatively easy method. If the patient use the drug simply as the outcome of a perverted appetite, an effort should be made to effect a cure before the operation. Although the writer feels that efforts of this sort are crowned only rarely with definite and lasting success. The patient should be confined under observation and the dosage of the drug gradually reduced, and if possible the patient should be entirely free from the use of the drug at the time of the operation. If this be not feasible, sufficient of the drug should be given to avoid the occurrence of confusing symptoms. If the operation be imperatively indicated and is undertaken before control of the habit is possible, the drug should be given on the day of the operation and surely immediately after. The writer had an unfortunate experience of this sort. The patient, a lady of 55, was subjected to hysterectomy for uterine fibroid complicated by tubal abscess. Not until she developed unfavorable symptoms which were exceedingly confusing did the patient's son make the attendants aware of the fact that the patient had used large quantities of morphin daily. The drug was given at once, but the patient died before the symptoms were controlled.

OBESITY

Operative technic involving remotely situated parts and organs is made exceedingly difficult by the presence of an undue amount of adipose tissue. Obese persons do not repair trauma with the same promptness as obtains in those endowed with a normal amount of adipose tissue. Adipose tissue of necessity has lessened resistance to infection. In instances where operation is to be undertaken at a more or less remote date an effort should be made to reduce the amount of fat before the surgical measure of relief is undertaken. In operations requiring celiotomy this is an exceedingly important consideration, as fat persons have a large amount of adipose tissue in the subperitoneal tissue and in the omentum.

Most writers divide adiposity into two classes, the hereditary and the acquired or dietetic kinds. The hereditary form of obesity is rare. Its occurrence is explained on the theory that the cell takes on a maternal or paternal impression and ultimately develops that impression. Cases of so-called hereditary obesity are difficult to manage and require prolonged and persistent treatment. The régime for these cases is similar to that of acquired obesity. To save repetition it will be taken up under that head.

Acquired obesity is absolutely and alone the outcome of excessive introduction of articles of diet into the digestive tract. Tissue is not built up from the air. With this principle in mind, firmly fixed and unswayed by the subterfuge of the patient, all cases of obesity can be reduced in weight. The hardship to the appetite and love of indulgence should be maintained during the period devoted to the preparation of the patient for operation and he be given the mental reservation that they may be indulged again when the operation is over. This is not unlike promising a child candy if he will eat meat first, but the method has its redeeming features.

Carbohydrates contribute most largely to the accumulation of fats in the body. However, large quantities of proteids will also be converted into fats. This latter fact must be borne in mind, and the patient must not be permitted to indulge himself up to distention with proteids.

The presence of a lung or heart condition causing fatigue readily, contributes to obesity by reducing the amount of work the patient feels capable of doing. Exercise will reduce adipose tissue, but if the exercise tend to overtax the heart it must be judiciously employed.

On the whole, a diet such as is employed in diabetes is as useful as any. (See Diabetes, page 34.)

All obese persons will lose weight on a diet consisting entirely of lean meat and hot water. However, this is a rather severe procedure and difficult to carry out. The practitioner need not cling absolutely to the principle of the withdrawal of the carbohydrates, if it be manifest that the patient's resistance is becoming low. A small quantity of starchy food may be given, but it should not be indulged in except to prevent the occurrence mentioned. For instance, sugar may be allowed with coffee once daily and a little stale bread allowed at dinner. Alcohol in all forms should be avoided, most certainly malt liquors should be absolutely withheld.

The fats and oils are perhaps less objectionable than the starches, but as little of these as exist in butcher's meat may be allowed. Butter should be avoided. This applies also to milk and its preparations.

The market has been flooded with various nostrums exploited as fat reducers. None of these have proven of value unless the diet be modified at the same time.

Thyroid extract has been used with perhaps more success than anything of similar nature. The extract is given in tablets of five grains, three times daily, after eating. The patient should be watched for circulatory disturbances during its administration—*i.e.,* rapid pulse, slight dyspnea, dizziness and faintness. When these symptoms occur administration of the agent should be discontinued.

In healthy persons who are obese as the outcome of indulgences alone, the measures indicated are surely effective. Exercise is a most valuable aid to the desired end. It is best to place the patient in the hands of a skilled trainer, one who opposes the patient's efforts and grades his resistance according to the capabilities of the patient rather than let him employ apparatus. If this be not feasible, the patient must be instructed just how far he is to go with his work.

It is a somewhat ridiculous picture to see a man with a wobbling paunch running about a track grunting and groaning, with two or three sweaters wrapped around him, taxing a sluggish heart with a view to preparing himself for a surgical operation. On the whole, the diet is the sheet anchor, and under no circumstances must the attendant permit of any modification of régime beyond the ones mentioned.

DIABETES

Diabetics, beyond taking very badly the narcotics by inhalation, are unfavorable surgical subjects, as they do not readily repair trauma. In diabetes of other than dietetic origin this may be due to general arterial disease.

Purely dietetic diabetes, or at least glycosuria, is readily remedied as regards the preparation of patients for operation. The other forms, while not so certainly benefited by treatment, nevertheless become much more favorable subjects for operation if the patient be subjected to dietetic régime for a period of several weeks before the operation, and certainly will make more rapid repair of the wound if the régime be maintained during convalescence.

In these cases it is not sufficient to inform the patient what he may not eat, but a complete diet list should be furnished, stating exactly what he may partake of. If there be any doubt in the patient's mind as to the propriety of his partaking of any special dish, he need only be informed to consult his diet list, and if the article in question be not listed it is not proper for him to consume it.

The accompanying diet table is one which will be found to meet the indications.

DIET-TABLE

In the strict anti-diabetic diet, any and all articles not mentioned in this table are interdicted. This applies especially to milk, which should never be used in any form.

BREAKFAST

Beefsteak—Beefsteak with fried Onions—Broiled Chicken—Mutton or Lamb Chops—Kidneys, broiled, stewed, or deviled—Tripe—Pig's Feet—Game—Ham—Bacon—Deviled Turkey or Chicken—Sausage—Corned-beef Hash, without Potato—Minced Beef, Turkey, Chicken, or Game, with poached Eggs.

All kinds of Fish—Fish-roe—Fish-balls, without Potato.

Eggs cooked in any way except with Flour or Sugar—Scrambled Eggs with chipped Smoked Beef—Picked salt Codfish with Eggs—Omelets plain or with Ham, with Smoked Beef, Kidneys, fine Herbs, Parsley, Truffles, or Mushrooms.

Radishes—Cucumbers—Water-cresses—Butter—Pot-cheese.

Tea or Coffee, with a little Cream and without Sugar.

Light red Wine for those who are in the habit of taking Wine at Breakfast.

LUNCH

Chicken Salad, Lobster Salad (meat of the Claws only), or any kind of Salad except Potato—Fish of all kinds, Chops, Steaks, Ham, Tongue, Eggs, or any kind of Meat—Head-cheese.

Red Wine or dry Sherry.

DINNER

Soups—*Consommé* of Beef, of Veal, of Chicken, or of Turtle—*Consommé* with Okra—Ox-tail—Turtle—Terrapin, without the Liver—Chowder, without Milk or Potatoes—Mock Turtle—Mullagatawny—Tomato—Gombo *filet.*

Fish, etc.—All kinds of Fish—Lobsters (meat of the Claws only)—Terrapin, without the Liver. (*No Sauces containing Flour or Milk.*)

Relishes.—Pickles—Radishes—Celery—Sardines—Anchovies—Olives.

Meats.—All kinds of Meat, cooked in any way except with

Flour—all kinds of Poultry, without dressings containing Bread or Flour—Calf's Head—Kidneys—Sweet-breads—Lamb-fries—Ham—Tongue—all kinds of Game—Veal, Fowl, Sweet-breads, etc., with Currie, but not thickened with Flour. (*No Liver.*)

Vegetables.—Truffles—Lettuce—Romaine—Chiccory—Endive—Cucumbers—Spinach—Sorrel—Beet - tops—Cauliflower—Cabbage—Brussels Sprouts—Dandelions—Tomatoes—Radishes—Oyster-plant—Celery—Onions—Water-cresses—*Artichauts*—Jerusalem Artichokes—Parsley—Mushrooms—All kinds of Herbs.

Substitutes for Sweets—Saccharine to sweeten coffee, tea, etc. Wine-jelly, without Sugar—*Gelée au Kirsch,* without Sugar—*Gelée au Rhum,* without Sugar—*Gelée au Café,* without Sugar—*Omelette au Rhum,* without Sugar—*Omelette à la Vanille,* without Sugar.

MISCELLANEOUS

Butter—Cheese of all kinds—Eggs cooked in all ways except with Flour or Sugar—Sauces without Sugar, Milk, or Flour.

Almonds—Hazel-nuts—Walnuts.

Tea or Coffee with a little Cream and without Sugar.

Alcoholic Beverages.—Claret—Burgundy—Dry Sherry—(*No sweet Wines.*)

PROHIBITED

Bread, Cake, etc., made with Flour—Milk—Sugar—Desserts made with Flour or Sugar—Vegetables, except those mentioned above—Sweet Fruits.

The dietetic régime should be assiduously carried out during the repair of the wound. During convalescence the ultimate recovery, that is, return to vigor, may be delayed as the outcome of rigid adherence to the ritual. In these instances a certain modification of the diet is permissible, careful watch being kept of the presence of sugar in the urine, which may reappear or increase in quantity as the result of the ingestion of carbohydrates. If none appear with a diet to which moderate amounts of carbohydrates are added, the diet may be constituted in this way for a considerable period of time, the urine being kept under espionage for the purpose of developing the fact whether sugar is present or not.

If a small quantity of sugar appear in the urine as the outcome of dietetic license, this may be regarded as a minor matter compared to the benefit derived from the administration of moderate quantities of carbohydrates during recovery from a surgical operation. If the sugar is not made to disappear entirely from the urine as the result of the diet, and the administration of a moderate amount of carbohydrates in the diet be followed by a sharp increase of glycosuria, it is best to maintain the anti-diabetic régime with rigidity.

As already stated, the wound is slow to heal in cases of glycosuria, and the immediate repair of the wound should provide for drainage for this reason, with the view of removing secretions, which, if retained, are likely to favor infection.

TRAINING OF TOLERANCE FOR MANIPULATION OF CAVITIES

In a general way it may be said that patients who have been subjected to manipulation in certain portions of the body are more tractable to the measures which become necessary immediately after operative procedure. For instance, a case of carcinoma of the tongue which is to be subjected to excision will have to be fed by means of a sterile stomach tube for some time after the operation.

The postoperative vomiting and the presence of infective secretions in the mouth require thorough cleansing of the cavity and the introduction of food by tube.

The gagging and rebellion at the measure when first undertaken, immediately or soon after the operation, are exhausting and disturbing. In these cases it would be well to create a tolerance for that sort of thing by educating the patient in this regard. The mouth should be kept clean as a matter of course because of the disease, and if the physician sees to it himself that the patient become habituated to the procedure, it will be of considerable aid to the attendant after the operation has been performed, in carrying out the measures required at that time. So is it with regard to feeding with the stomach tube. In all operations about the mouth considerable blood secretions and solutions are swallowed by the patient during the operation, and this should be removed by washing. In addition, if the patient be trained to assist in the introduction of the stomach tube before the operation, the necessary manipulation will be found much easier after the operation is performed.

The same principle applies to the rectum, urethra, and vagina. Conditions in these situations which necessitate operation usually call for more or less prolonged after-treatment, and if the patient be accustomed to manipulation the expediency of the after-treatment will be much enhanced.

These form a factor of some importance, especially when the operation is undertaken for conditions which have already severely taxed the resistance of the patient. There is no doubt that primary union or rapid repair will take place most readily if the nutrition and general condition of the patient is at its highest possible level during the period immediately following a severe operation. The pain, annoyance, and apprehension attendant upon the first post-operative manipulation may be avoided or at least considerably lessened if the factors stated above be regarded.

This is best exemplified in children and women and applies to a lesser extent to men. It also argues for the viewpoint from which this book was written, that a large proportion of the necessary work in surgical practice is advantageously taken up by the general practitioner, whose relationship to the patient is such as to warrant the expectation that the best possible ultimate results will be obtained if this apparently unimportant element of the problem be handled by him.

CHAPTER II

PREPARATION OF THE PATIENT

The sick room—The bed—Catharsis—General preparation of the patient—Diet—Preparation of the operative field in clean cases—Preparation of the operative field in infected cases—Attire of patient about to be removed to operating room.

THE SICK ROOM

The sick room should be large and sunny, with a southern exposure. It should be entirely emptied before being occupied by the patient. This means that all pictures and ornaments are to be removed, including hangings and curtains. The walls and

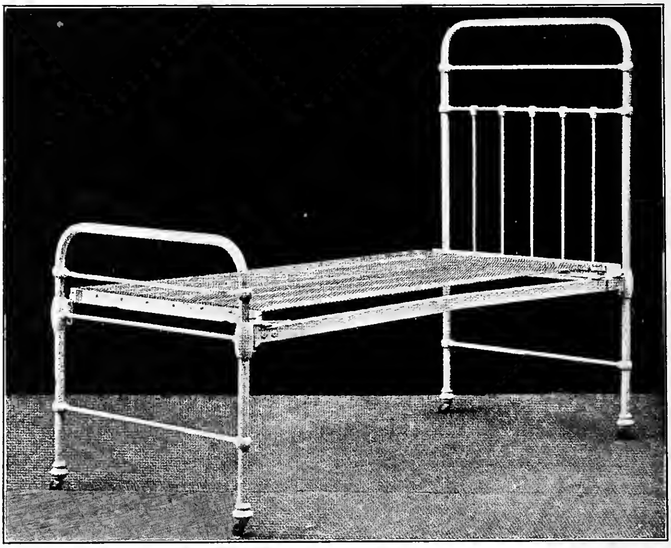


Fig. 10.—Bed Suitable for Abdominal Cases.

ceiling should be wiped with a solution of corrosive sublimate (1-1,000) after the dust from mechanical cleansing has settled. Dust screens, consisting of gauze fastened to the ordinary adjustable fly screens, should be placed in the windows. The window shades should be removed, unrolled, wiped with corrosive sublimate solution, and replaced. All sewer connections, stationary wash basins, etc., should be sealed. The pictures, etc., should not be replaced, for if the patient becomes delirious they might provoke illusions.

THE BED

The bed should be single, with freshly-aired linen and a rubber sheet beneath the sheet. A plain iron bed is preferable for the purpose, and this should be of the height from the floor, usually used in hospitals (26 inches to the top of the fabric). (Fig. 10.)

Fig. 11.—Bed Suitable for Head Cases.

The illustration shows a bed with a rather high head-piece. This is desirable in certain cases, especially when it is expedient after the operation to raise the upper portion of the patient's body on pillows, such as is the case following gastro-enterostomy. On the other hand, the bed shown in Fig. 11 is more serviceable in cases involving operations on the scalp and skull, the low head-piece making these parts more readily accessible, in changing dressings, etc. An ordinary iron bed may be raised on improvised wooden stilts having a socket for the reception of the bedposts (Fig. 12).

This arrangement renders the patient more accessible to the attendant and nurse. A desirable refinement which contributes not a little to the facility with which the necessary manipulations are performed. Also, the space under the bed is more readily kept clean, and the fact that this is visible prevents the placing of bed pans or other objectionable apparatus under the bed.

If feasible, the bed should be so placed as to render both sides of the patient readily accessible at the same time. This enables the attendant to approach the patient from one side of the bed, and the nurse to supply needed dressings, etc., from the other.

A serviceable arrangement of the sick room is shown in Fig. 12.

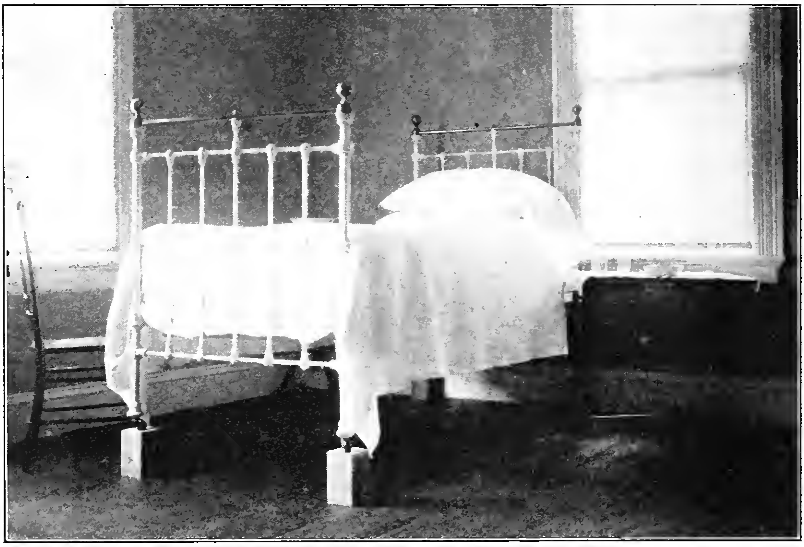


Fig. 12.—Arrangement of Bed and Sick Room in Private Practice.

The light comes into the chamber from two directions. The patient utilizes that coming from behind the bed for reading, and the light entering at the side is available for the purpose of dressing the wound, scrutinizing the patient, etc.

When convalescence is established, various ornaments may be placed in the room, and these replaced by others at intervals with the view of interesting the patient.

Besides the bed, the room should contain a small oblong table covered with a clean towel or folded sheet upon which dressings, medicines, etc., for use of the nurse may be placed. Bed pans, catheters, etc., should be placed in a convenient closet not within sight of the patient.

The temperature of the room should be maintained at about

70° F., and it should be ventilated thoroughly at least once a day, taking care that the patient be protected from sudden changes of temperature.

The room must be kept scrupulously clean during the after-treatment. Dusting should be done with a damp cloth. The nurse in charge of the case should take care of the cleansing of the room herself, and this labor should not be turned over to domestics or members of the patient's family.

The patient should be kept in bed for the entire day before the operation and half the preceding day.

CATHARSIS

Thirty-six hours before the operation five grains of calomel are administered. This is followed the next morning by half an ounce of Sal Rochelle. At noon an enema of soap and water is given and if regarded necessary, because of moderate action from the measures already employed, the enema is repeated in the evening. Subsequent to this no further disturbance of the contents of the bowel is permitted, on the ground that a stool just before an operation is objectionable for obvious reasons, among which may be mentioned the fact that during the straining incident to the primary stage of narcosis a stool may be discharged, rendering the precautions already mentioned negative.

Because of this possibility some surgeons do not administer a cathartic for twice twenty-four hours before the operation. When it is remembered that the gut is an exceedingly important eliminative organ, and that decomposition of the end products of digestion will take place at times in a few hours, and that the technic of abdominal operations is not a little more difficult when distended gut is persistently obtruded into the wound, the latter rule is perhaps not as universally to be recommended as the former. Indeed, the practitioner should in this regard, as in all other problems, not cling to a hard and fast rule, but make use of the general principle laid down and modify it to meet the immediate indications.

If the operation is to be performed in the morning the thirty-six hour rule is a good one, but it is to be remembered that the morning hour for operation is not always without objections, not the least of which is the fact that the immediate preparation of all the paraphernalia necessary to a major operation consumes much time, and that, as a rule, the assistants who do this work are, for many causes incident to the common mode of life, apt to be late at their posts and to hurriedly and perhaps more or less indifferently perform their duties. It is not by any means uncommon to find that the best interests of the patient are conserved by a more leisurely preparation for the operating room during hours most usually devoted to work by the vast majority of people.

If, then, the operation is to be performed in the afternoon, the last enema should be given at 7 A.M.; that is, beginning the morning of the day preceding the operation the calomel is given at 10 A.M., the saline at 3 P.M., the first enema at 8 P.M., and the last cleansing enema at seven of the morning of the day of the operation, and the operation done at 2 o'clock or later in the day.

With this arrangement, the patient goes to bed at the usual hour the night preceding the day before the operation and remains in bed the next day and, indeed, until the time of operation. The bath is, of course, given on the evening preceding the day before the operation.

GENERAL PREPARATION OF PATIENT

Kocher insists that the patient be given a complete bath the day before the operation. The bath is taken in a warm bath room, and the patient liberally lathered with soap by an assistant. *Kocher* regards mechanical cleansing as more effective than the effort to neutralize infective material with antiseptics. The surgical cleansing includes the scalp, hair, finger nails, mouth, pharynx, and genitals.

He regards antiseptic applications as irritating and liable to provoke eczema, and believes it is sufficient to wash the operation field with ether and alcohol after it has been shaved and thoroughly cleansed with soap and water; this is to be followed by an aseptic protective dressing. In the presence of skin disease, however, antiseptics are to be employed.

Kocher also advises cleansing of mucous membranes which are in communication with the air. The mouth and nose should be cleansed. Tartar is removed from the teeth, preferably by the dentist, this to be followed by thorough cleansing with soap and water and lavage with a one-fourth per cent. carbolic acid solution. Strong antiseptics in the mouth and nose give rise to hypersecretion and do more harm than good. Nasal crusts are readily removed with a solution of sodium bicarbonate (page 362). Plugs of sebum are to be removed from the tonsil.

Moynihan has each patient furnished with a new tooth-brush and a bottle of antiseptic mouth wash, and the nurse is instructed to cleanse the mouth every two or three hours during the day. *Harvey Cushing* has shown that by careful attention to cleansing of the mouth, and by the sterilization of the food, the alimentary canal may be rendered comparatively sterile. The import of the latter proposition will be more extensively considered in connection with the preparation of patients for operations on the gastro-intestinal canal (page 424). Parotiditis and aspiration pneumonia are both liable to occur from neglect of thorough cleansing of the teeth and mouth.

The fact that absolute inactivity on the part of the patient immediately after an operation is necessary for many reasons, makes it difficult for the nurse to give attention to the care of the hair. In female patients this is an important factor. The head is to be shampooed the day before the operation, which may be done at the time the bath is given. After thorough drying, an ointment containing a small portion of sulphur should be rubbed into the scalp. This will prevent the caking of excessive secretion of sebum, especially should the patient be bedridden for a considerable period of time after the operation. The hair is then braided and fastened to the top of the head. If delirium occur, the presence of the hair on the back of the head is objectionable and a source of annoyance as the patient tosses from side to side.

In male patients it is best to cut the hair quite short and rub in the sulphur ointment. The beard should be trimmed close if shaving is not permitted. The almost inevitable vomiting following operations soils the beard, and should cleansing be postponed as the outcome of the necessity of maintaining absolute quiet for a considerable time, is a source of infection which should be avoided.

The scalp encrusted with sebaceous secretion is an exceedingly favorable " nahrboden " for bacteria, and it is not uncommon to see a patient scratch the scalp and hold the finger nails charged with bacteria over the wound as the surgeon changes the dressing. Patients will reach for the region of the surgical trauma when painful manipulations take place, and though ordered to "keep the hands away," usually disregard the admonition until after the damage is done.

Incidentally it would be well for the surgeon to bear in mind the necessity for a clean scalp, as it not infrequently happens that sebum falls from the head to the wound as the surgeon is bending over the patient changing a dressing. Indeed, hospital internes serving with the writer are not permitted to wear a beard, and are compelled to keep the hair of the scalp short. As a rule, this is not a hardship to members of the house staff, as they are usually at a time of life when a beard is not worn. However, it is respectfully suggested that surgeons do away with beards or at least wear them closely trimmed.

DIET

It would seem most rational to administer to patients about to be operated on a diet which will leave the least residue, require the least possible effort in the process of digestion, and at the same time not reduce the resistance of the patient. If the patient presents no complication, such as is taken up in the preceding chapter, the matter is a simple one. These considerations have been sufficiently discussed and do not call for reiteration here.

Unless specially contraindicated the meal taken thirty-six hours before the operation may consist of all the three general divisions of substances of diet, *i.e.,* proteid, carbohydrate, and fat. It is difficult to see why any hardship should evolve on the patient in this respect, as this meal will undoubtedly be entirely consumed by the next morning. If restriction be made at all the patient is ordered to use only lean meat, and well hydrated carbohydrates, *i.e.,* a light dinner may be taken consisting of chicken, a fresh vegetable, and toasted bread.

During the day before the operation, *i.e.,* when the patient is in bed, the diet should be more restricted. Much has been said of the value of fluid forms of proteids of various kinds, yet it is no doubt the opinion of most clinicians that none of these contain the essential albuminoid or proteid necessary to the proper nourishment of the human animal. None of the preparations on the market to-day are regarded by the writer as of genuine nutritive value. They have a certain place, they please the sense of taste perhaps, or render other substances less monotonous, yet they consist very largely of the inorganic salts and certain flavors extracted from meat fiber, and do not contain the necessary and eminently essential proteid.

However, milk contains all the elements necessary to the maintenance of human life, and, indeed, in a readily assimilable form. It has been proven again and again that adult life can be maintained indefinitely on a purely milk diet. Not alone is this true, but the physical endurance of individuals who are subsisting entirely on milk is as great as that of persons taking ordinary articles of diet.

Milk is deficient in iron. However, for the purpose of preparing a patient for operation, this fact may be disregarded. It is perhaps true that the casein of milk causes fermentation in certain individuals. This may be overcome by the addition to the milk of lime water, or by peptonizing it. As a general rule, milk obtained from a properly regulated dairy, properly handled, in a manner now so widely understood, is as universally useful an article of diet as can be employed during the day immediately preceding an operation. The quantity should, according to the weight of the patient, be between two and four quarts in the day, but rarely less than the two quarts. Eggs, given raw or made into a custard, may be allowed, and if the milk be given besides, the quantity may be correspondingly reduced.

The writer warns against the indulgence in fads in this regard. The starvation of patients for a day or two before an operation is absolutely unscientific and irrational. It is perfectly easy to see that a patient about to be subjected to a severe strain upon the vital forces is better able to withstand the trial if the energies have been conserved by the proper administration of food, which is, of course, the only source of energy there is. Whatever objections there may be to a diet of milk and eggs as regards its disturbing influence on digestion in certain cases need not be considered in this connection. The patient will be in bed, undergoing preparation for an operation, and if he have some digestive disturbance this may be readily neutralized by catharsis, etc., which is, as already stated, a part of the preparation for operation, and if, last of all, the digestion of milk and eggs be accompanied by distress, it is well for the patient to accept the situation for the period of time indicated, in order to achieve the benefits of increased resistance, the outcome of the diet.

Of course no food whatever is given for six hours before the operation. The last nutritive substance introduced into the stomach may consist of properly prepared milk.

PREPARATION OF THE OPERATIVE FIELD IN CLEAN CASES

It is quite impossible to sterilize absolutely the skin. This is due to the fact that the hair follicles and ducts of the sebaceous and sudoriperous glands are the habitat of bacteria and that these cannot be removed or entirely destroyed. It is probable that great activity of the skin, *i.e.,* sweating, will mechanically remove bacteria from the location mentioned. This explains the rationale of a warm bath before an operation. The perspiration is fertilized as it passes along the ducts through the skin. If perspiration be prolonged the sweat becomes quite sterile. However, the quantity of excretion must be large before this is accomplished.

In this connection it is proper to say that rarely, if, indeed, ever, is the technic of an operation achieved without contamination of some kind. Infection is the outcome of fertilization. Infection, at the same time, requires a certain dosage of fertilization. The aim of the surgeon should, therefore, be to lessen, as much as is possible, the dose of infective substance and thus accomplish an aseptic result. This justifies the elaborate preparation employed in properly conducted operating rooms.

Again, it is worthy of note that infection occurs more readily in even the best equipped operating rooms than it does in private residences where no case has ever before been subjected to operation. This should be explained by the facts stated above.

Infection, too, is rare where large quantities of fluids are used in cleansing, provided the fluid is free from bacteria, *i.e.,* the bacteria present in a given area will exhaust themselves in a sterile media and die, if they have to fertilize an overwhelmingly large sterile area. This is along the lines of the law of dilution and sedimentation. A typhoid stool deposited fifty or sixty miles away from the place where water is used for drinking purposes will be so diluted after the water has traveled the distance as to do no harm, especially if the watershed be added to by tributaries free from typhoid bacteria *en route*.

This principle should be borne in mind. Cleansing of the skin has its physics as well as a chemistry and a physiology. As a general rule, antiseptics must remain in contact with bacteria for a long time in order to destroy them. It would be better to lavage a given area of skin with several gallons of boiled water than to sop on the area a small quantity of an aseptic solution, *i.e.,* if the contention expressed above is logical.

Bacteria are certainly more readily attacked in fluid sebum than when they inhabit dry collections of sebaceous matter which plug up the excretory passages of the skin. We have, then, the epidermis, the excretory ducts, and the hair to consider as the parts in which bacteria habitually reside.

The hair is removed by shaving. The excretory ducts are opened by warmth and consequent perspiration, the epidermis is softened with water and the residual sebum is saponified with soap which is sufficiently alkaline to form a saponification with the fat in the sebum, and is mechanically removed by liberal lavage with sterile water.

The problem is thus discussed rather at length, on the ground that the laying down of hard and fast rules is not wise, for the surgeon has not always available everything which would make possible the carrying out of certain measures, and if the principle here laid down is borne in mind, the desired result may be achieved in many ways. Certain methods of skin cleansing will be here stated, but they may be modified at will, provided the general principle is adhered to.

Dry serum may be rendered fluid by oil. Therefore, the skin to be sectioned may be gently anointed with olive oil which has been boiled. This is left in contact with the skin for several hours, and is applied immediately after the general bath. The area is then thoroughly soaped and the hair shaven.

Shaving is an art. Aside from the pain and annoyance to the patient consequent to the use of a dull razor, especially in untrained hands, the skin is likely to be scratched and the little raw surfaces left are favorable places for the invasion of infection.

Nurses should be trained to shave properly. In male cases it is best to have the part shaven by a barber if this be feasible. Female patients, as a rule, and occasionally male patients, object to being shaved on portions of the body usually covered by the clothing. Frequently female nurses are diffident about attacking the area with a razor. In these instances, if there be ample time for preparation, it is perhaps justifiable to use a depilatory mixture. The following formula has been compiled by Dr. W. E. Dreyfuss, and is efficacious:

Barii sulphid	parts 25
Saponis pulvis	parts 5
Talci veneti pulv	parts 35
Tritici farine	parts 35
Benzaldehydi	q. s.

Make teaspoonful of the powder into a paste with three teaspoonfuls of water, and apply to the parts with an ordinary shaving brush in a moderately thick and even layer. After four to five minutes the parts should be moistened with a sponge and after another five minutes the hair can be removed by washing off the mass. The part is then deluged with a large quantity of sterile water of a temperature of 100° F.

For this purpose the patient is placed on a large-sized "Kelly pad" (Fig. 13). The illustration shows three forms of Kelly pads suitable for various purposes. A is a form very serviceable in dressing abdominal wounds, the apron being carried over the edge of the bed or table, and the cleansing fluid allowed to run down on either side of the patient's body, being led into a proper receptacle by means of the apron. B and C are similar in essential respects, except that the apron of B may be hooked upon itself and form a receptacle for the cleansing fluids. Both B and C are largely employed in cases of operations and cleansing of wounds with the patient in the lithotomy position. The pad rests under the patient's buttocks, and the apron hangs over the end of the table. The pad is made of rubber and the edge is furnished with an air compartment which is blown up through the little metal tube visible at the edge. The metal tube is supplied with a valve which permits air to enter, but none to come out. This arrangement prevents the cleansing fluids from wetting the bed. Next, a sterile pad is applied to the part, wet with sterile water, and left in contact with the skin for several minutes. The water again

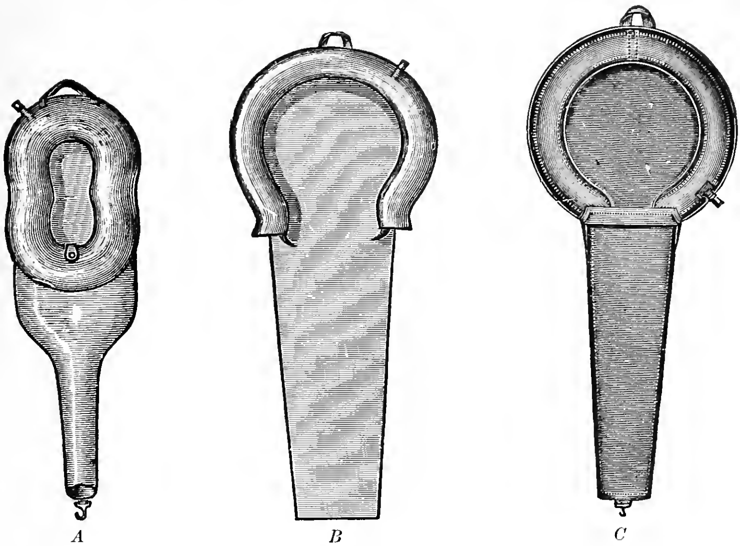


Fig. 13.—Kelly Pads. *A*, used for cleansing abdomen; *B* and *C*, used for cleansing perineum with patient in lithotomy position.

should be warm, not hot, as hot water irritates, but warm enough to aid in emptying the sweat ducts. It also softens the epidermis, which is then more readily removed. After removing the wet pad

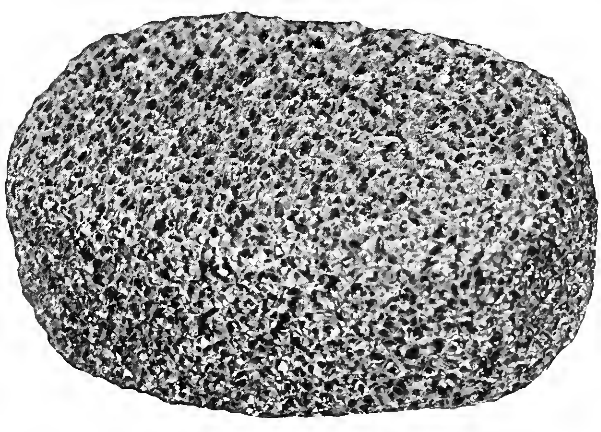


Fig. 14.—Rubber Sponge for Cleansing Skin.

the skin is thoroughly soaped with tincture of green soap, using a piece of gauze or a rubber sponge (Fig. 14), not a brush. These sponges may be boiled, and they make a lather more readily than gauze. The writer has seen the skin made to bleed by an over-strenuous assistant, and has been compelled to postpone the opening of a knee joint for this reason. The soaping should be gentle and somewhat prolonged, causing a free lather, which is ultimately displaced by a liberal lavage with sterile water.

Ether is next poured over the skin. The ether is used with the view of removing the small portion of oil which still occupies the excretory ducts. This is a useful measure when properly used, but it is to be remembered that ether evaporates very rapidly, and if it have in solution any oil, will leave the latter in contact with the skin in the form of an exceedingly thin film, which is, of course, not fluid because of the refrigeration from the ether; thus the application of ether may do more harm than good.

The application of ether to be effective must be immediately dislodged by a large quantity of sterile water at a temperature of about 80° F., for ether boils at the temperature of the body and may, when mixed with hot water, burn the dependent parts of the body, especially if proper drainage be not provided for.

The part is now covered with a protective dressing, consisting of a thick layer of sterile gauze, on top of which a layer of cotton is placed, the latter being impervious to bacteria. The dressing is held in place with appropriate binders or bandages.

The measures related above have proven effective in the hands of the writer. However, if they be not feasible because of the cumbersomeness of the manipulations, antiseptics may be used.

Moynihan has the skin cleansed with soap and water much in the same way as is mentioned, using a wipe for the purpose. An antiseptic compress is then applied and left for twenty-four hours. The compress consists of two or three layers of lint soaked in 1 per cent. formalin, 1 in 60 carbolic, or 1 in 2,000 biniodid of mercury solution. He prefers the former, believing a deeper penetration of the skin and glands is obtained. In any event, the latter two solutions are quite apt to irritate. There can be no objection to this method if it be supplemented with large quantities of sterile lavage. At the end of twenty-four hours a second washing is performed and a second compress applied. *Moynihan* does not insist upon the second washing, as it is a trifle trying to a delicate skin.

Whatever method is used, the case should be cleansed again upon the operating table. It would seem that as a general rule the second washing may be omitted. If there should be any small furuncles or cracks in the skin, they should be rendered sterile with pure carbolic acid. The acid is applied with a cotton daub twisted on the end of a probe and the acid neutralized with alcohol at the end of a few moments. The actual cautery may be employed for the purpose.

PREPARATION OF THE OPERATIVE FIELD IN INFECTED CASES

Operation on patients who present infection require slightly different preparation.

The general principle is that of antisepsis rather than asepsis. If infection exists, it means that the character of the fertilization is such as to have overcome resistance, and it is probable that the method of sterilization of the field of operation effective in clean cases requires additional chemical aid.

That it is feasible to obtain aseptic repair of the skin in the presence of infection is proven by the fact that operations performed within an area of erysipelas have given this result. These operations in the hands of the writer have been undertaken under antisepsis. It is not improbable that the incision within the zone of erysipelatous inflammation and the liberal lavage with corrosive sublimate solution has a beneficial effect upon the erysipelas itself, a conclusion which is justified on the ground that the infected tissue was made more accessible to the direct contact with the antiseptic.

Indeed, the writer has attacked the mastoid cells, the lateral sinus and the internal jugular vein through an erysipelatous zone with favorable outcome. *Maylard* has removed sequestra from long bones in cases where sinuses existed, both in tuberculous osteomyelitis with mixed suppurative infection, and in suppurative osteomyelitis of long standing with aseptic healing. In these cases microscopical examinations of scrapings of the epidermis contiguous to the sinuses and of small portions of skin excised from the region of the sinuses have shown no bacteria.

The preparation of these cases is as follows: The skin is anointed freely, but not forcibly, with 20 per cent. oleate of mercury. The applications extend over several days and are employed over the entire field of operation twice daily. Before each application following the first one the residual oleate and the softened epidermis is removed by careful, prolonged, but gentle soaping with a gauze wipe and the combination of soap, oil, sebum, and bacteria mechanically removed with a solution of corrosive sublimate 1 in 1000. The solution is poured onto the field from a pitcher and a gallon used at each sitting.

This procedure is carried out morning and evening for three days before the operation. At the last cleansing—*i.e.,* the one on the evening before the day of the operation—the sinuses, if any, are wiped out with pure carbolic acid and this neutralized with alcohol. Then a dressing is applied similar to that mentioned above. (Page 50.)

No application of the oleate is made at this time. Here again modification of detail is permissible, *i.e.,* carbolic acid solution 1 per cent. or formalin solution 1 per cent. may replace the corrosive sublimate solution. Carbolic acid solution will soften the epidermis more, but will also cause maceration of the true skin if applied for too long a time. This objection does not apply to formalin, but the latter is more irritating than corrosive sublimate.

The theory is palpable. The skin is penetrated by the oleate of mercury, the bacteria destroyed and later removed by lavage. It is probable that repeated application of the procedure is necessary to accomplish the desired end. As in clean cases, the bath and warm water are used. Indeed, the method is quite similar to that used in clean cases except for the employment of antiseptics and the somewhat more protracted preparation.

To prevent contamination of the operation field from the contiguous skin *Murphy* of Chicago employs the following measure.

After preparation of the skin in the usual way a "rubber dam" is applied to the field of operation, consisting of a thin sheet of elastic rubber of about the thickness of the rubber gloves. The rubber sheet is sterilized in the same way as is dry catgut and can be procured in the market done up in sterile packages ready for use. After the skin is prepared the rubber is slightly moistened with ether, rendering a minute section of the diameter of the rubber fluid, it is then stretched over the skin with considerable traction and put in place. The rubber immediately adheres closely to the skin and prevents the invasion of the wound by infective substances. The incision is made through the rubber, and when repair is made the sutures are taken through it. At last the rubber is lifted at one end, and after incising it where the sutures penetrate it, removed.

The rubber dam is not affected by antiseptic solutions used during the operation, and, being more elastic than the skin, does not interfere with free manipulations of the part. In cases where suppurative discharges are prolonged, or in cases subjected to colostomy or cholecystotomy, or in the presence of fistulæ of various kinds, the dam may be used over a considerable period of time and replaced at intervals to allow of cleansing of the skin beneath.

ATTIRE OF PATIENT ABOUT TO BE REMOVED TO OPERATING ROOM

The attire of patients about to be subjected to operation should be arranged to render accessible the part to be attacked, with a minimum of exposure of the rest of the body, and at the same time protect the patient from undue exposure to either cold or heat.

The former propositon, *i.e.*, protection from cold, is, as a rule, carefully taken care of. The latter, however, is perhaps too frequently disregarded. It is to be remembered that heat stroke may occur as the outcome of neglect of precautions in this regard. When the abdomen is opened the general rule is to prevent contact with cold air on the part of the contents of the abdomen. This is obviously a correct principle. Yet the writer cannot help but feel that a patient covered in part by impervious rubber sheeting, layers of woolen blankets to absorb irrigating fluids, sterile sheet, and layers of sterile towels, together with immediate contact with three or more adults who surround the operating table in various capacities, is getting about as much heat as is necessary, if not more.

A glance at the bluish face, with little streams of sweat running down the neck of a narcotized patient should sound a warning in this connection. Especially is this true in operating rooms where the apparatus for the sterilization of instruments and utensils is located in the operating room. The necessity for having available means of rapid sterilization of instruments, etc., during an operation will be gone into more extensively under a separate head, yet mention of the proposition in this connection seems proper.

The writer has seen cases of exceedingly high temperature immediately following operations, with some delirium and rapid pulse, which have aroused alarm and caused some confusion as to diagnosis. The fact that the temperature was readily reduced with cold applications, and that no subsequent evidence of infection appeared, seemed to justify the belief that the disturbance was due to heat stroke. Indeed, in the summer service at the large hospitals the standardization of postoperative fever is slightly at variance with what obtains during the other seasons. A temperature of 103° F. immediately following an operation does not arouse much alarm unless it persists into the second or third day.

Fig. 15.—Patient Attired for Conveyance to Operating Room.

As a rule, the temperature of the sick room or hospital ward should be such as to permit of disrobing the patient without the occurrence of chilly sensations. This, as stated, should be about 72° F. During convalescence the temperature of the sick room may be lowered to 68° F. However, the general notion of comfort in disrobing is a good standard to go by. Ordinarily a patient should be able to disrobe in a ward or sick room without feeling cold. The artificial methods of producing heat should be so regulated as to permit of this and at the same time allow of free ventilation.

Of course, this is not an easy problem, yet if the room be kept at 70° F. and the ventilation arrested during the dressing of wounds, scrubbing, etc., and then immediately therafter the ventilation be reëstablished, the desirable result is obtained.

Before removal to the operating room the hair is wrapped in a sterilized towel. A short shirt, also sterilized, is put on and fastened behind with a single button at the neck. This permits of change of garment immediately after operation with a minimum of disturbance of the patient. The legs are encased in long linen stockings, which have also been sterilized. Of course, these garments are not sterile when the patient reaches the operating table. However, they should be sterilized before being applied, on the ground that this lessens the quantity of fertilizing substances in contact with the patient. Fig. 15 shows a patient attired as described.

CHAPTER III

STERILIZATION AND PREPARATION OF INSTRUMENTS AND DRESSINGS

Sterilization of instruments—General sterilization—Steam dressing sterilizers—Requisites for a major operation.

STERILIZATION OF INSTRUMENTS

All surgeons agree that boiling is the safest and most simple method of sterilizing instruments. Instruments to be rendered sterile should be boiled for twenty minutes. The apparatus used for the purpose varies in character with the conditions under which the operation is to be done. The elaborate nickel-plated boilers

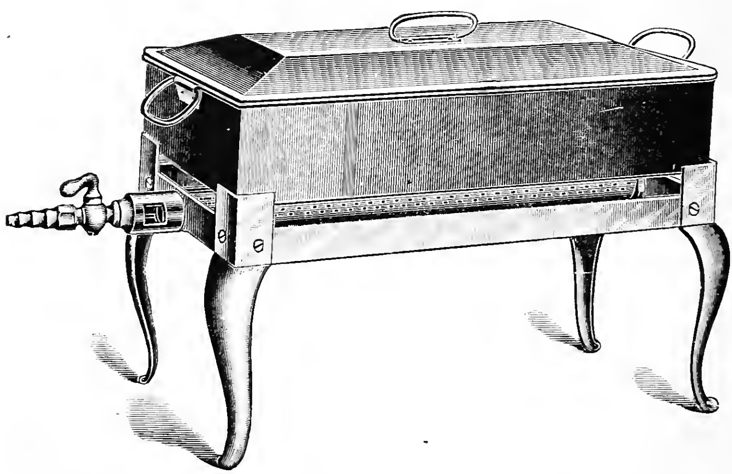


Fig. 16.—Instrument Sterilizer Suitable for Hospital or Surgeon's Office.

in use in hospitals and in surgeons' offices, while desirable, are not essential to the end in view. Several kinds of apparatus for the purpose are shown in the accompanying cuts (Figs. 16 and 17).

Fig. 16 shows an apparatus which is exceedingly useful and very largely used. It is made of heavy copper, tinned inside and nickel plated outside, with a detachable bottom tray which permits of removal of the instruments without disturbing the boiler. This particular boiler is fitted with a gas Bunsen burner, but the same apparatus is obtainable furnished with either alcohol, petroleum or electric heating attachments.

Fig. 17 shows practically the same apparatus, except that there is no burner attachment, and this may be employed either with an alcohol flame or set directly upon a stove. For the latter purpose the legs are detachable. This apparatus is useful for con-

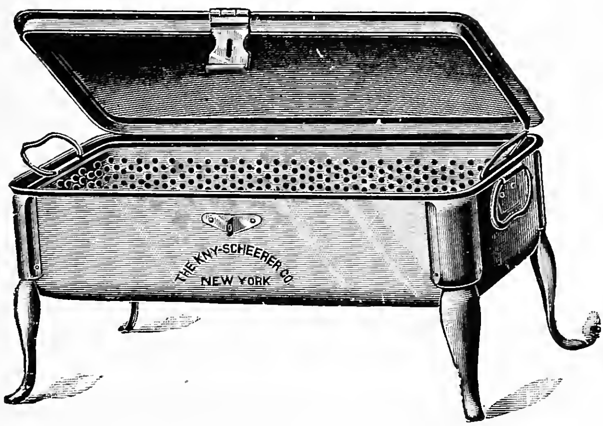


Fig. 17.—Portable Instrument Sterilizer, with Detachable Legs.

veying to the scene of operation instruments, which may then be sterilized by boiling as circumstances demand, in accordance with the source of heat available. This illustration shows the perforated tray, which permits of the easy removal of the instrument. The tray is lifted by the handles shown, which are turned inward when the lid of the boiler is closed.

Both of these boilers are very useful and contribute much to the facility with which instruments are sterilized. Yet it is to be understood that they are not by any means essential to complete and thoroughly effective sterilization.

The method of procedure consists of exposing the instruments to a temperature of 212° F. for twenty minutes. The instruments are placed in the removable perforated tray, and after this has been lowered into the sterilizer they are submerged in a solution of sodium carbonate or borax (2 per cent.) and boiled.

It is readily seen that the object may be accomplished by any apparatus which will hold water and stand heat. A fish boiler, or even an ordinary saucepan found in any household, is as effective for the purpose as the more elaborate sterilizers described. However, it is to be remembered that water and nickeled instruments have certain incompatibilities and that a rusty instrument is exceedingly objectionable.

For this reason the soda or borax are added to the water, the theory being that as the instruments are withdrawn from the sterilizer the soda crystallizes on their surface and in the joints of the instruments, and absorbs the last few drops of water which may remain in contact with them. Thus rusting is prevented. This is a plea for an apparatus which permits of the withdrawal of the instruments, together with the containing tray, allowing of quite complete drainage of the water.

It is worthy of note that the impurities in tap-water, such as the lime, salts, combined with other foreign substances, held in solution in the water, cling to the instruments, and cause discoloration. Pure water is not likely to cause discoloration of the instruments. Also, chemically pure soda or borax should be used, as these, too, cause discoloration if impure.

An objection to the boiling of instruments is the fact that excessive heat destroys the edge of cutting instruments. It is, of course, feasible to boil all other instruments and subject cutting instruments and needles to chemical sterilization. This, however, is expensive and slow and by no means as certain as heat.

The sterilization of instruments with smooth surfaces is readily accomplished by immersion in pure carbolic acid for twenty minutes, followed by lavage with alcohol, the latter removing the carbolic acid most efficiently. *Lysol,* which contains some soap, is largely used for the purpose and is effective. It also permits of subsequent exposure to irrigating fluids with less damage to the instrument than the former method. It is, however, not as certainly effective as the carbolic acid-alcohol method.

Mercury destroys instruments. Contact with this agent should be avoided when feasible, though this is, of course, impracticable when corrosive sublimate solutions are used as an irrigation during the operation. Recently a preparation of mercuric iodid has come on the market which seems to have no deleterious effect upon instruments. It is used in solution of 1 in 1000, and the instrument should be submerged for twenty minutes. In this, as in other instances, pure water should be used.

Grosse of Munich has devised a method of heat sterilization for knives which seems to be of value and does not cause rusting.

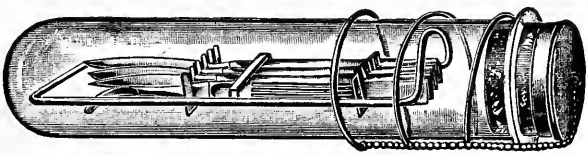


Fig. 18.—Glass Tube with Knives for Steam Sterilization.

The knives are placed in a metal rack (Fig. 18), which is slipped into a glass tube provided with a stopper. The entire tube, after being closed, is placed in an ordinary steam pressure sterilizer (page 62) and treated as described under the head of dressing sterilization.

For the purpose of sterilizing a single knife, a smaller rack and glass tube (Fig. 19) may be used. The knife is held securely by the metal wire suitably bent for the purpose, so as to protect the edge. The tube is closed by absorbent cotton used as a stopper. After exposure to steam for ten minutes the knife is absolutely sterile, and no specks are visible on it.

Traces of condensed steam are observable inside the tube upon the glass, which, however, disappear rapidly after the tube is withdrawn from the apparatus. This is explained on the ground that steam generated from the small quantity of hygroscopic water contained in the atmospheric air inclosed in the glass container always precipitates upon the glass, which is specifically colder, and not on the steel, which has a larger capacity for heat.

Fig. 19.—Single Knife in Glass Tube Ready for Steam Pressure Sterilization.

If it is desirable to sterilize a number of knives each in a separate container for each operation, a number of tubes arrayed as described may be conveniently placed in a rack, as shown in Fig. 20. This would seem to involve less danger of contamination during handling than if the four knives are simultaneously placed in one rack and larger glass tube.

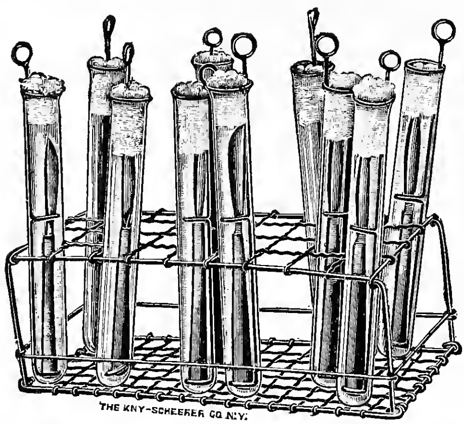


Fig. 20.—Rack for Holding Knives in Separate Containers, Ready for Steam Pressure Sterilization.

GENERAL STERILIZATION

In well-equipped hospitals all material coming in contact with the patient is sterilized by heat. Here is undoubtedly the most effective agent for the sterilization of gowns, towels, dressings, etc., used in surgical technic; yet it is not at all times applicable to the varying conditions under which operations have to be undertaken. In the latter instances chemical sterilization is a necessity, and, it may be said, if patiently and carefully carried out, is as effective as heat.

Of course a judicious combination of heat and chemical sterilization, together with mechanical cleansing, is almost always obtainable—*i.e.*, towels may be boiled and even gowns may be boiled and put on wet in case of necessity. Yet, if it be feasible, steam heat should be used for the purpose, as it renders them sterile and more readily handled.

The most desirable method of sterilization will be taken up first, and then the modifications necessary because of absence of the desirable apparatus will be discussed.

The principle underlying the sterilization of all material coming in contact with operative wounds is the outcome of the discoveries of *Pasteur* made known in 1879. The relationship which bacteria bear to infection was first demonstrated by this indefatigable worker. The researches of *Koch* and *Wolfhuegel* are based upon the observations made known by *Pasteur*. Sterilization by heat is the outcome of the experimentation of the two former observers.

The first attempt to destroy pathogenic substances was made by *Darrow* and *Symington*, two English physicians, who, in 1850, subjected the clothing of cholera patients to dry air at a temperature of 220° to 250° F. by baking in a crude oven. The measure was exceedingly effective.

Although various physical agents, such as heat, cold, light, and dryness, possess power to destroy bacteria, heat is the most effective agent, and the one most readily obtained and controlled for the purpose. *Sunlight and certain concentrated forms of artificial light* are capable of destroying bacteria, yet the process necessary to accomplishing the desired end is a prolonged one, and by no means as certainly effective as heat.

Cold is a feeble bactericidal force. Frost, which has been so generally regarded as destructive to malarial and yellow fever poisons, is now believed to destroy only the carriers of infection—*i.e.*, the mosquito—and leave the infecting agent unharmed.

Dryness destroys the cholera germ, but is a condition favorable to the growth and life of bacteria generally.

Dry heat will destroy bacteria. It requires a temperature of 150° to 165° C. to accomplish the object, and the exposure must continue for one hour.

Moist heat at a temperature of 100° C. will destroy all bacteria and spores in a few minutes.

This should be borne in mind in instances where steam heat is not available for sterilization and baking of dressings, etc., if an oven is used for the purpose. Steam and air have certain molecular antagonism in a given area, until there is an equalization of the difference in expansion in these two bodies. This accounts for the peculiar inequality of action of apparatus for sterilization which does not allow of the removal of air from the sterilization apparatus before the steam is forced in.

The potency of steam heat in destroying ineffective organisms depends upon the temperature. While it is true that anthrax spores will be destroyed by a temperature of 90° C. in twenty minutes, only five minutes of exposure to a temperature of 95° C. is required.

The thermal death point of bacteria bears a certain relationship to the coagulability of albumin. When albumin containing bacteria is in solution, or in a moist state, it requires comparatively little heat to destroy them. On the other hand, if the albumin culture medium is dried, it will withstand a high degree of temperature for a long time. When moist heat at 100° C. comes in contact with a spore it is killed just as soon as it absorbs enough moisture to allow of coagulation.

A sterilizer, then, to accomplish the purpose most readily and thoroughly, should be so constructed as to achieve the following: elimination of air from the sterilization chamber, the penetration of the objects with steam fully saturated, the prevention of condensation of water on the objects.

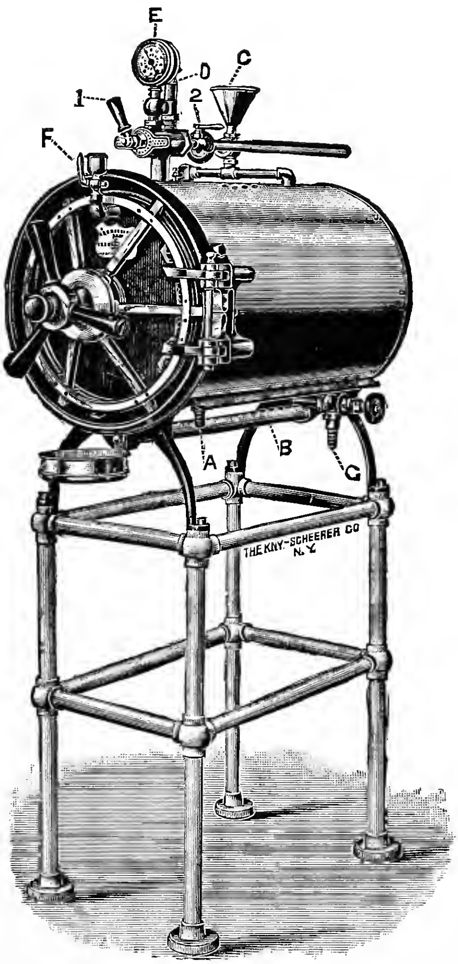


Fig. 21.—Steam Pressure Sterilizer for Dressings, Etc.

STEAM DRESSING STERILIZERS

In large institutions where steam power plants are constantly in operation for the purpose of furnishing heat, power and light, steam is readily available, and is led into the outer jacket of the steam sterilizer by the means of pipes which coil in the outer water jacket and heat the water to the desired temperature. However, in most instances, this condition of affairs is not available, and the water in the outer jacket is heated by means of a gas Bunsen burner placed beneath the apparatus.

As a matter of fact, it makes no difference from which source the heat is obtained, as long as it is of sufficient quantity to develop the temperature required for sterilization. Oil, alcohol, etc., are as effective in this regard as coal or illuminating gas. Electricity, while effective, is expensive and requires much time to produce the necessary temperature, though ideal in cleanliness and elasticity of application. For the purpose of this work, it is sufficient to describe the apparatus usually employed with a gas Bunsen burner. A complete description, together with illustration (Figs. 21 and 22), is given.

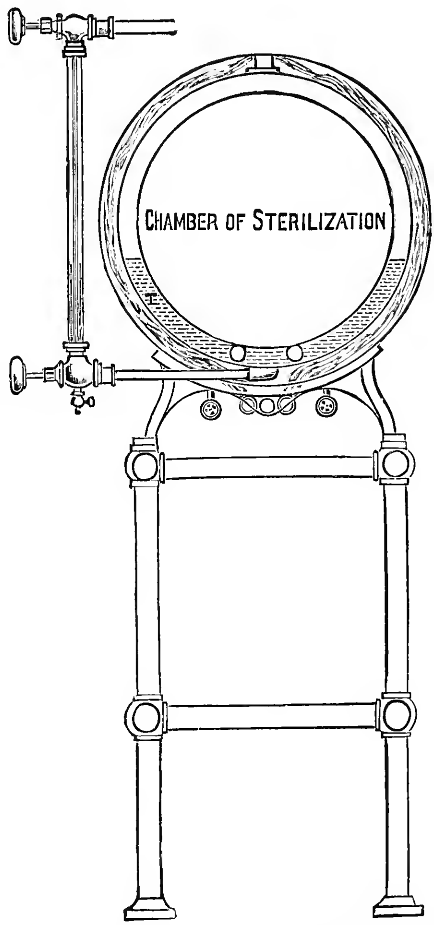


FIG. 22.—SECTIONAL VIEW OF STEAM PRESSURE STERILIZER SHOWN IN FIG. 21.

1. Fill the steam jacket with clear water by opening valve on metal funnel C, turning lever No. 1 to the right. The quantity of water required for sterilization depends on the length of time for which the apparatus shall be operated. It is not desirable to have the jacket filled more than half full of water (see sectional view, Fig. 22). The glass water gauge on side indicates exactly the height of water jacket.

2. A permanent connection with the hydrant water supply can be made through valve "G" (the clean-out valve) by connecting

a Tee back of valve " G " and using a gate valve on the Tee, to which you connect your hydrant water. This method of filling the water into the jacket works rapidly, and in addition offers the advantage to be able to inject water at any time even though the apparatus may be under pressure and in operation. The pressure of the water supply at point of entrance at valve " G " must, of course, exceed that of the steam pressure in the jacket; the latter being fifteen pounds per square inch, it follows that the water pressure should at least be twenty-five pounds or more.

3. The steam jacket having been filled with a sufficient quantity of water, throw lever handle No. 1 back to the left and light the burner (gas, petroleum or alcohol) leaving valve on funnel C open until steam issues, then close it tightly. The combination steam pressure and vacuum gauge E will register the conditions prevailing in the jacket and the steam pressure safety valve D will blow off steam as soon as the latter exceeds the normal pressure of fifteen pounds (= 1 Atmosphere).

4. The dressing material should be placed into the sterilizer chamber before the heaters are lit or, as in the case of steam-heated jackets, before the boiler steam is turned into the heating coils. Door of sterilizer is locked securely and air filtering cup valve F, which is filled with a wad of absorbent cotton, is left open, handle being in vertical position as shown in drawing, Fig. 22.

Gradually as the temperature of the water in jacket increases, the air in the sterilizer chamber becomes rarefied and finds an escape through cup valve F. The sterilizer chamber, therefore, in the first stage of the process serves the purpose of a hot-air oven, gradually warming the dressings preparatory to letting pressure steam into the chamber.

5. As soon as the combination steam and vacuum gauge E indicates a steam pressure of fifteen pounds, the safety valve will begin to operate by blowing off steam in excess of the required pressure, then close the air filtering cup valve F by thrusting handle into a horizontal position.

The moment has now arrived for exhausting the already rarefied air in the sterilizer chamber by creating a partial vacuum. This is done by opening valve No. 2 on the steam exhaust pipe and by throwing lever No. 1 to the right. The combination gauge E will soon register a vacuum in the chamber, five inches being sufficient to insure absolute results.

When this degree of vacuum has been reached, close valve No. 2 whereupon the pressure steam will rush into the chamber. The dressing material contained in the latter, having thus been carefully prepared by the air exhaust process for an eager absorption of live steam, will instantaneously and thoroughly be penetrated by the same. Furthermore, since the inrushing steam, which is of a temperature of 250° F. (121° C.) will meet with material which has for some time been subjected to dry hot air of nearly the same degree of temperature as that of the pressure steam, the latter will not condense, and therefore not wet the dressings. The process of steam sterilization shall last from twenty to thirty minutes.

6. The dressing material can now be considered absolutely sterile, and may be taken out at once if desired. It is advisable, however, to let it remain in the sterilizer chamber for from ten to twenty minutes longer in order to remove every trace of dampness. For this purpose open valve No. 2, and again start the exhausting process described under No. 5, for the time above specified. After this, extinguish flame or shut off steam supply, close valve No. 2 and throw lever No. 1 to the left.

7. To remove sterilized dressings from the chambers, it is necessary to destroy the vacuum in the latter in order to be able to open the door. This is done by letting air enter the chamber through the air filtering cup valve F, which is filled with absorbent cotton.

Dressings thus prepared can be absolutely depended upon as to their sterility. They may be left in the apparatus for an indefinite time before being used without becoming infected.

The noise made by the blowing off of the steam in creating the partial vacuum is exceedingly annoying. This may be overcome by leading the blow off by means of a steel pipe into the open air at some convenient place near the apparatus.

Of course, the handling of the material subjected to these measures is performed by a person whose hands are not sterile. Consequently, the material must be placed in an outer container which will allow of handling without contact with non-sterile substances.

For this purpose the gowns, wipes, towels, etc., are enclosed, in convenient quantities, in muslin wraps, and these opened at the time of operation by an attendant who is definitely detailed to the work of handling all material between the sterilizer and those coming in contact with the wound.

Indeed, at all operations one such person is in attendance for the purpose of handling the solutions, changing the posture of the patient, etc., and this portion of the work may be done by this person. This, however, will be more largely taken up under the head of operating room technic.

The expense of the apparatus described is not so great as to be an important factor in causing the adoption of simpler means of heat sterilization. However, the object can be obtained by the use of apparatus which is less expensive and less complicated. In view of the fact that all dressing material, towels, wipes, etc., may be sterilized and packed in air-tight packages and kept for a long period of time, it is suggested that the surgeon had best draw upon some central plant for the material mentioned, rather than rely upon means which involve modification of the principles here laid down.

Indeed, it has been found that thoroughly reliable material may be obtained from commercial houses which prepare dressings, gowns, sheets, etc., which are necessary for a given operation, place the entire outfit in a convenient box, and are prepared to ship the same to the surgeon or the patient's house at short notice.

REQUISITES FOR A MAJOR OPERATION

A specimen outfit is here described. This particular outfit is designed to be used for celiotomy, and can be readily modified to meet the indications of most any surgical contingency which may arise.

The list given here is an elaborate one, and is elastic in the sense that successful work may be done with less material, though, as a general rule, it is best to err on the side of safety. Again, if the surgeon is in a position to resterilize material left unused, nothing has been lost. Indeed, it is suggested that the surgeon furnish himself with an outfit as described which will form the basis of his stock on hand and act as a guide in this regard.

The list does not include suture material, which is taken up under separate head.

2 four-quart white enamel pitchers.
1 two-quart white enamel pitcher.
4 white enamel basins.
1 gown for self and each assistant and nurse.
1 cap for self and each assistant and nurse.
1 pair armlets for self and each assistant and nurse.
2 pair rubber gloves for self and each assistant and nurse.
4 demijohns of sterilized and distilled water.
6 oz. tinct. green soap.
3 sterilized nail brushes.
3 sterilized orange wood sticks.
3 bone nail cleaners.
1 bottle of chlorinated lime (8 oz.).
1 bottle soda carbonate (granular 8 oz.).
3 dozen sterilized gauze pads with tapes.
6 dozen sterilized wipes.
3 sterilized celiotomy rolls.
2 packets sterilized absorbent gauze (5 yards each).
1 pound sterilized absorbent cotton.
3 tubes iodoform gauze, 5 yards by 6 inches.
3 tubes plain sterilized gauze, 5 yards by 2½ inches.
3 sterilized combined dressings.
2 sterilized binders (many tailed).
1 sterilized T binder.
3 cigarette drains.
2 rubber tube drains.
3 bottles bichlorid of mercury tablets.
1 bottle carbolic acid (6 oz.).
1 box boracic acid.
2 dozen bottles sterilized salt.
4 dozen sterilized cotton towels (soft).
1 dozen sterilized vulvar pads.
1 tube of sterile lubricant.
1 sterilized self-retaining catheter No. 16 French.
1 sterilized self-retaining catheter No. 20 French.
1 sterilized glass catheter.

1 bath thermometer.
1 rectal tube.
1 four-quart sterilized douche bag and glass nozzle.
1 roll 2-inch adhesive plaster.
1 celiotomy sheet.
2 sterilized rubber sheets.
Hypodermic tablets, strych., morph., and nitroglycerin.
Duck suits and canvas shoes for surgeon and assistants.

The four-quart pitchers are filled with cleansing solutions, one with an antiseptic, usually bichlorid of mercury, the other with saline solution. The two-quart pitcher is used for replenishing the larger two as the necessity arises. The pitchers are sterilized by boiling or by thorough lavage and subsequent immersion in bichlorid of mercury solution. After being filled, they are covered with a sterile towel (Fig. 70).

In the edge of the folded towel a safety pin is fastened allowing of lifting of the towel (Fig. 71) by the non-sterile nurse, who pours the sterile contents, as shown in Fig. 71, without contaminating them. A serviceable arrangement of pitchers is shown in Fig. 70.

The enameled basins are sterilized in the same manner as the pitchers, and are used for solutions employed for cleansing the hands of surgeons and assistants (Fig. 76).

Gowns should be of ample size and arranged to be fastened with tapes at the back of the wearer. Though the forearm is cleansed before operating, it is best to cover it with sterile fabric. For the purpose, gowns with long sleeves, as shown in Fig. 86, or a similar gown with short sleeves and detachable armlets, may be employed. The advantage of the latter is that, when the sleeves become soiled during an operation, they can be quickly changed without disturbing the gown. The sleeves of the gowns worn by the assistants who do not come in contact with the wound may be long, and will not require changing during the operation.

Caps.—The object of the cap is to prevent the falling of hair and impurities from the scalp into the wound or upon the material coming in contact with the patient. While aseptic results are common when this precaution is not taken, it is best to employ the additional measure of safety. The surgeon and assistant should wear a mask and cap combined (Fig. 84). This prevents contamination from beard, mouth, and perspiration.

In operative work done in public clinics where the operator lectures during the operation, this is slightly objectionable. However, in these instances the mask need not cover the lips, and the surgeon may take the precaution to turn the head away from the wound, while speaking. It is not uncommon to see perspiration, the result of the high temperature of the operating room or, perchance, of certain vasomotor disturbances due to emotional causes, drip into the wound. This should be avoided, though it may be said that after prolonged perspiration the sweat washes the excretory ducts quite free from contaminating bacteria.

The mask should be made of sufficient thickness and of sufficiently absorbent material not to require changing during an operation.

Rubber gloves are either boiled and slipped on wet or, perhaps better yet, boiled, dried, dusted with lycopodium, packed in gauze, and sterilized under pressure, together with dressings and gowns. The subject of gloves is taken up more extensively under the head of cleansing of the hands (page 126). The gauntlets of the gloves should extend over the cuffs of the gown (Fig. 82).

The sterilized and distilled water is used for cleansing and lavage. It is more desirable to have the water distilled to remove all foreign bodies, yet water may be sterilized by boiling. One-half the water on hand should be hot and the other cold. Tap water may be boiled in two large tin receptacles, covered up, and allowed to cool. A short time before the operation one of the boilers is heated, the other left cold to allow of elasticity in the adjustment of temperature during the operation.

Soap is most commonly used in the form of the tincture of green soap. This is employed with the view of saponifying the fat on the skin. It is, however, a wasteful method, as much of the fluid is allowed to escape. A jar of green soap (Fig. 76) is perhaps as useful a means of keeping soap as any, though there is no objection to using the ordinary laundry soap (Fig. 76).

Nail brushes should not be sufficiently stiff to scratch the hands. They are boiled and placed in a glass jar together with the orange sticks and submerged in bichlorid solution. The nail cleaners are also boiled and placed, together with the soap, brushes, and lime and soda containers, on a suitable table near the washstand (Fig. 76).

The calcium chlorid is placed in an open dish and the sodium carbonate in a similar one. These dishes are of white enamel, and are placed on the table prepared for the surgeon, as shown in Fig. 76. The method of use is taken up under the head of cleansing of the hands (page 126).

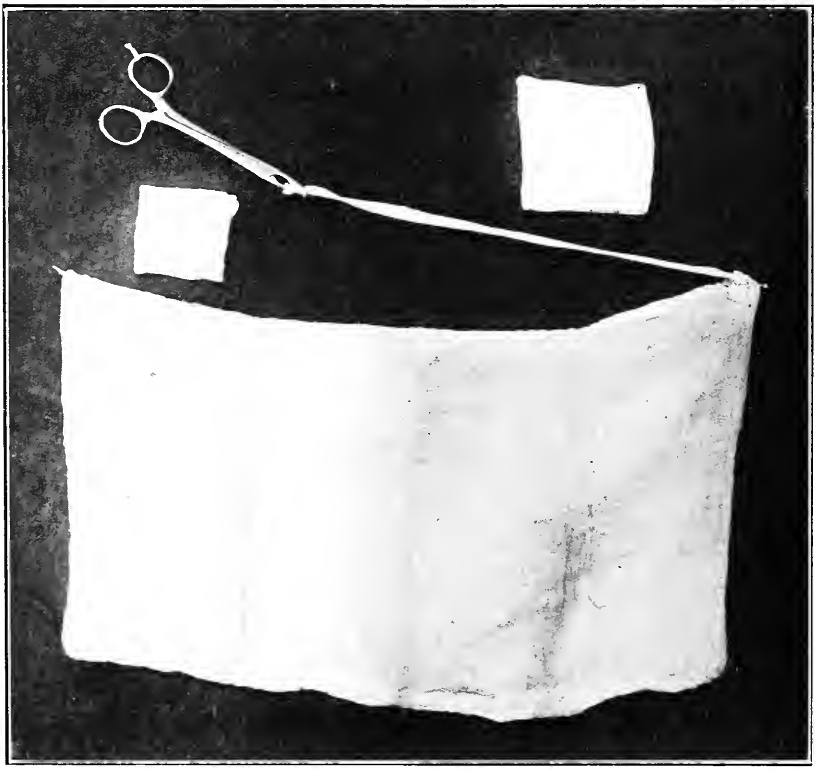


FIG. 23.—GAUZE PAD WITH TAPE AND FORCIPRESSURE AND WIPES OF TWO SIZES.

The gauze pads are prepared as follows: Cut gauze in squares 12 inches by 12 inches, leaving an extra margin of one-quarter of an inch for seam. Place three of these squares one upon the other so as to have three thicknesses of gauze. Sew around the four sides, leaving an opening at one corner through which to turn the pad inside out, so that the frayed edge of the seam is inside. This prevents small shreds of gauze from being left in

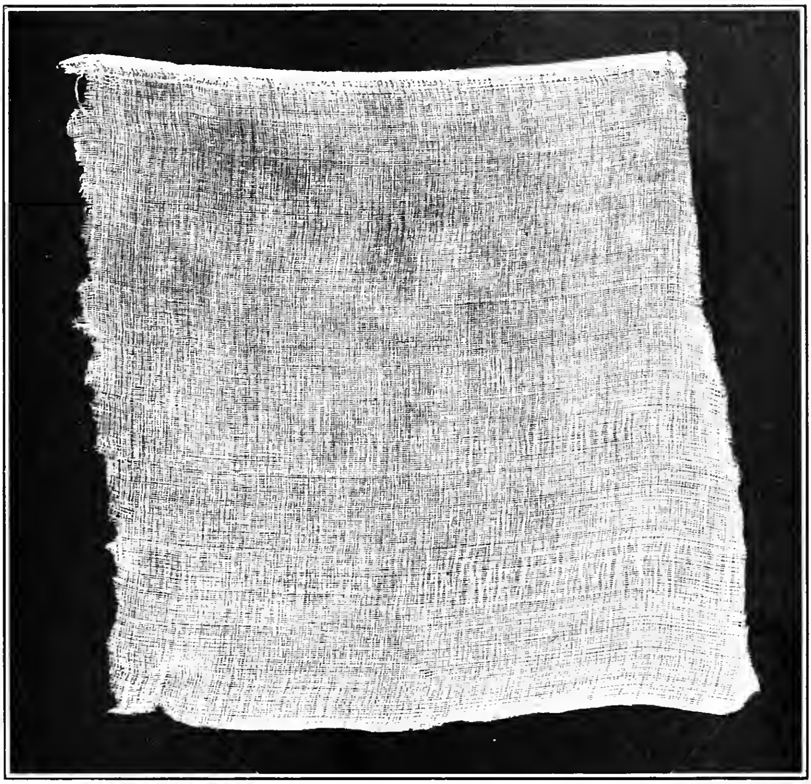


Fig. 24.—Gauze for Making Wipe.

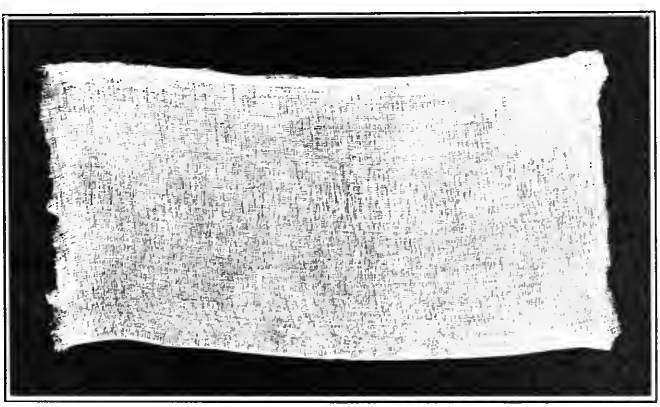


Fig. 25.—Gauze Folded Once.

the wound, which act as foreign bodies when this precaution is disregarded. After the pad is turned the small opening at one corner is finished off and a tape 6 inches long and one-fourth inch wide is attached firmly to the corner last closed, so as to have all

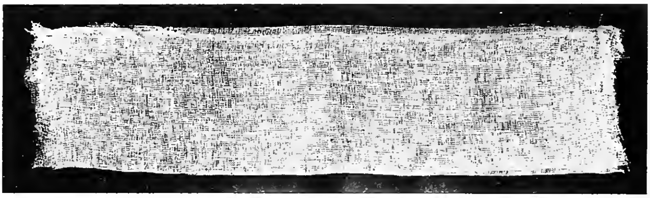


Fig. 26.—Gauze Folded Twice.

stitching at one place. This tape is intended for the attachment of forcipressure, which latter hangs out of the wound, so that the pad may not be lost or forgotten. When finished the pad appears as shown in Fig. 23.

Six of these pads are folded in a gauze wrapper, then in a muslin wrapper, then labeled, and are then ready for sterilization. The wrapper is employed in hospital practice and in instances where the surgeon has a large demand for the material. In private practice, however, the wrapper may be replaced by any convenient container, such as a towel or a paper box, etc.

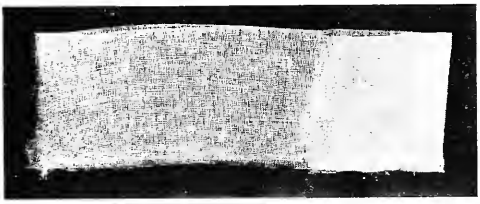


Fig. 27.—Gauze Folded One-third of Length.

Wipes vary in size, the usual and perhaps most universally useful size being four inches square. The description here is that of the size mentioned, but is equally applicable to other dimensions. Cut gauze into oblongs 12 inches by 16 inches (Fig. 24), fold lengthwise (Fig. 25), fold lengthwise a a second time (Fig. 26), fold one-third of length (Fig. 27), fold again in the same direction (Fig. 28). Take in right hand and

Fig. 28.—Gauze Strip Folded Two-thirds of Length.

with left hand take the outer layer of gauze at open end (Fig. 29), and turn wipe inside out (Fig. 30), permitting the passage of both hands through the one side (Fig. 31). Turn the wipe and repeat the turning process on the opposite side, allowing of the manipulation shown in Fig. 32. This turns in all frayed

FIG. 29.—MANNER OF HOLDING FOLDED GAUZE PRELIMINARY TO INVERTING EDGES.

edges. Wipes of two by two inches are treated in the same way. Fig. 23 shows the three sizes most commonly employed. The packing and preparation for sterilization is similar to that described under pads (page 72).

Gauze pads are used to pack off operation fields in cavities.

In certain instances, however, it is preferable to employ long pieces of folded gauze, which permit of greater adaptability, and also involve less danger of being left behind. For the purpose, gauze two yards long and one yard wide is folded on itself lengthwise three times, becoming thus four inches wide and consisting of eight layers. The gauze is then rolled (Fig. 33)

Fig. 30.—Manner of Inverting Folded Gauze Strip.

and treated as described under sterilization of pads. At times rolls of less diameter are preferable. To attain this it is only necessary to reduce the size of the original piece and handle as before.

Two packages containing each five yards of sterile gauze are prepared. The gauze is prepared in the same way as for celiotomy rolls, being four inches wide when folded, and two yards in length.

The gauze is used for the protective dressing. It may be cut into shorter lengths or folded more narrowly to suit the necessities of a given case.

Sterilized cotton is furnished in cartons by the manufacturer, in varying quantities. It is best to use several packages of small

FIG. 31.—GAUZE WIPE COMPLETED. Front view, showing edges inverted.

size than run the risk of contamination in using larger ones on more than one occasion.

Gauze for dressings and packing may be packed in tins or glass tubes. Here again the container should be of the size holding a quantity to be used for a certain case, and if a portion of the gauze be unused, this had best be destroyed and a new container used each time. Fig. 34 shows a desirable form of glass tube container. Medicated gauzes are not as largely used in surgical practice as formerly. The two kinds most commonly employed are iodoform gauze and gauze saturated with balsam of Peru.

Fig. 32.—Wipe Completed (back view).

Iodoform gauze is prepared as follows:

Pulv. iodoform	oz. vj.
Glycerin	O. j.
Alcohol	oz. viij.
Ether	oz. viij.

Place iodoform in sterile basin carefully and completely break up lumps with sterile spatula, add glycerin, gradually rubbing into a paste. Add alcohol and mix. Add ether and mix. Roll gauze, prepared as for celiotomy (Fig. 33), in mixture, until all ingredients are absorbed. Place in layers in sterile towel, pin

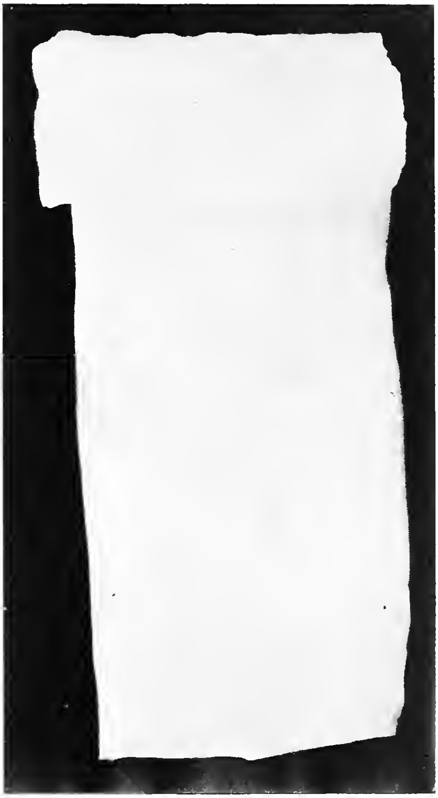


FIG. 33.—GAUZE ROLL, SUITABLE FOR PACKING WOUNDS AND CAVITIES.

tightly. Pack in oil silk, inclose in second sterile towel, and sterilize. The gauze may be cut to any desired size.

Balsam of Peru gauze is prepared as follows:

Balsam of Peru ....O. j.
Glycerin ....oz. 1.

Mix in basin and treat as instructions with iodoform gauze.

A combination of gauze and absorbent cotton is a desirable agent for the protective dressing. It is absorbent, and the cotton is impermeable to bacteria.

Combined dressing is prepared by cutting gauze 12 by 12 inches. A layer of this is laid flat and cotton is smoothly laid on it, the latter being made smaller than the gauze so as to permit

Fig. 34.—Gauze for Packing in Glass Container.

of overlapping of one inch all around. A second layer of gauze, similar in size to the first, is placed on top of the cotton (Fig. 35). Six of these dressings are placed in a packet and sterilized.

Fig. 36 shows a transverse section of combination dressing cut squarely, for purposes of illustration, with the scissors. It will be noted that the cotton fills the space between the two layers of

Fig. 35.—Making Combined Dressing. The top layer of gauze is being placed in contact with the layer of cotton.

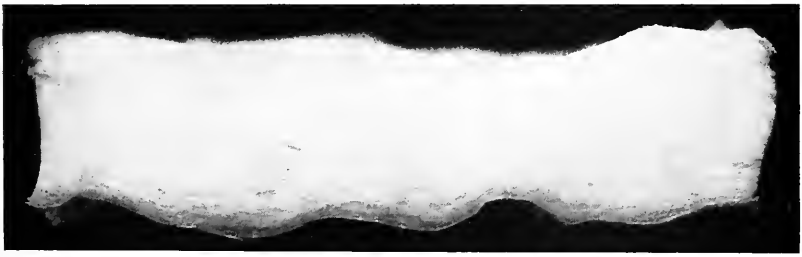


Fig. 36.—Transverse Section of Combined Dressing.

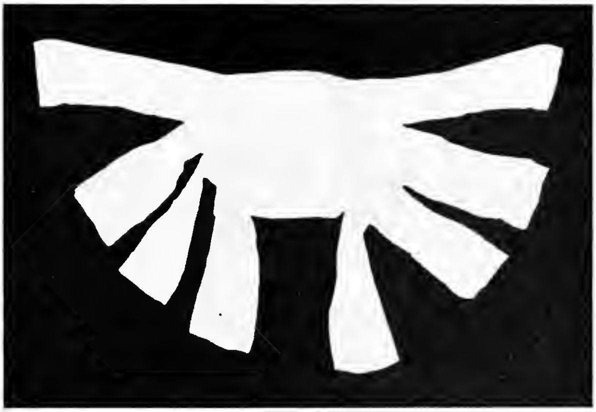


Fig. 37.—Many-tailed Abdominal Binder.

gauze, which are quite clearly outlined in the figure. In this way a smooth surface is presented for the retaining bandage.

The many-tailed binder is made of heavy muslin or Canton flannel and is arranged with a solid back and fashioned in tails at the sides (Fig. 37) to allow of better adjustment to the body. Its method of application is taken up together with the abdominal protective dressing (page 436).

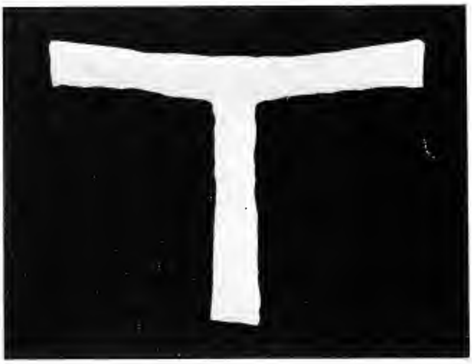


Fig. 38.—T-Bandage for Holding in Position Perineal Dressings.

The T binder is used for operations about the perineum (Fig. 38). Its application is taken up with operations in this region (page 548).

Cigarette drains are made by rolling gauze in rubber tissue. It is essential that the gauze extend beyond the rubber tissue and that the gauze be wet in order to facilitate capillarity. (See Fig. 154.)

Rubber tube drains (Fig. 39) vary in size and length. They have a distinct and valuable field of usefulness in infected cases, where they can be introduced at the dependent portions of wounds and cavities. They will not, like textile fabric drainage, drain up hill. The figure shows a desirable method of preservation. The tube is boiled and inclosed in the glass tube, submerged in sterile water, and after the tube is sealed, again boiled. When introduced into a wound the tube is fenestrated with the view of facilitating the entrance of infective material through its entire length. The mode of application of this agent is described under separate head (page 189).

Fig. 39.—Sterile Rubber Drainage Tube in Hermetically Sealed Glass Tube.

Sterilized salt is placed in bottles in powder and then sterilized again under pressure. The quantity in a bottle is regulated so that the entire contents of a phial are used to make the desired percentage of solution when added to two quarts of water. Chemically pure sodium chlorid should be used. However, even this is apt to contain fine, insoluble particles. To obviate this a concentrated solution of the salt is made, which is carefully filtered through a clay filter and placed in tubes similar to those employed for drainage tubes, etc. A sufficient amount of this concentrated solution is placed in a single tube to correspond to the amount of salt necessary to give the required strength to two quarts of water.

When salt solution is used for infusion or hypodermoclysis, the necessity for an absolutely clear solution is manifest. Hermetically sealed tubes, as described, are obtainable in the market. They are exceedingly convenient and are inexpensive (Fig. 40). Just

FIG. 40.—CONCENTRATED SALT SOLUTION IN HERMETICALLY SEALED GLASS TUBE.

before use they should be boiled. Care should be taken in breaking open the narrow end so that no particles of glass be allowed to drop into the solution.

Sterile towels should be of soft cotton. New towels contain a dressing which makes them stiff. This renders them less pliable, and they do not lie close to the parts. When an instrument or other apparatus is placed on a new towel it is liable to slip and fall to the floor. The towels should be soaked in cold water over night, washed in soap and water, cleansed by rinsing in several changes of clean water, dried in the air, folded in convenient squares, wrapped in muslin, and sterilized under pressure. The function of sterile towels is to surround the operative field with sterile surfaces. The mode of use is taken up under operating-room technic (page 167).

Self-retaining catheters are described under bladder drainage. In this connection, however, it is proper to state that they should be boiled, placed in a glass tube similar to the one used for drainage tubes, and resterilized under pressure. They may be boiled and wrapped in muslin and thus transported, or boiled immediately before the operation, together with instruments. The latter method is the safest.

Lubricating agents are best used in collapsible tubes (Fig. 41A). The tubes are readily sterilized and are filled with a jelly made of cartilage, which is soluble in water. The use of lubricants which are soluble is desirable as compared with the oleaginous ones, permitting of more thorough cleansing of the lubricated surface.

When using lubricant in the urethra the adjustable cone (Fig. 41B) is a desirable refinement, permitting of the easy introduction of the lubricant into the urethra or other canal.

Bath thermometer (Fig. 42) is necessary to determine the temperature of solutions used for lavage of the wound. Not infrequently solutions are used which are too hot, scalding the tissues and interfering with repair of the wound. An accurate determination of the temperature of solutions employed will prevent this.

Fig. 41.—*A*, Lubricant in collapsible metal tube; *B*, Cones for injecting lubricant into cavities.

A rectal tube (Fig. 43) should be on hand to permit of enteroclysis during the operation, and for the purpose of introducing various solutions into the bowel during the after-treatment.

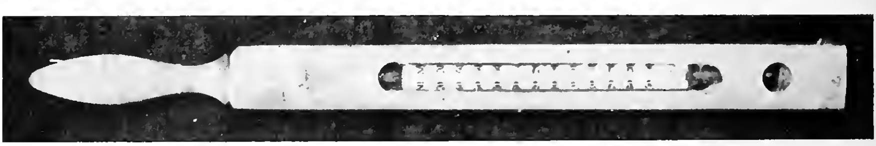


Fig. 42.—Bath Thermometer for Determining Temperature of Solutions.

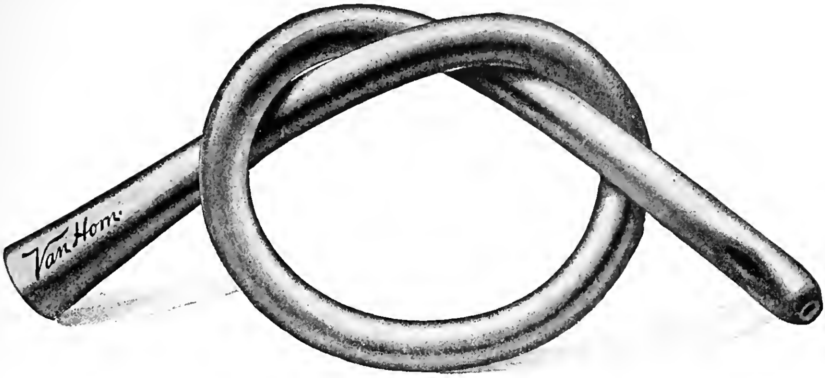


FIG. 43.—SOFT RUBBER RECTAL TUBE.

Douche bags are used for irrigation, and as a reservoir for solutions to be introduced into the bowel. They have been largely replaced by glass tanks, but the latter are used mostly in operating rooms in hospitals, the former being more readily transported for use during operations in the homes of patients. The bag is so much more readily transported as to have a distinct field of usefulness. A glass terminal at the end of the rubber tube is desirable. The bag should be boiled before using. The subject of

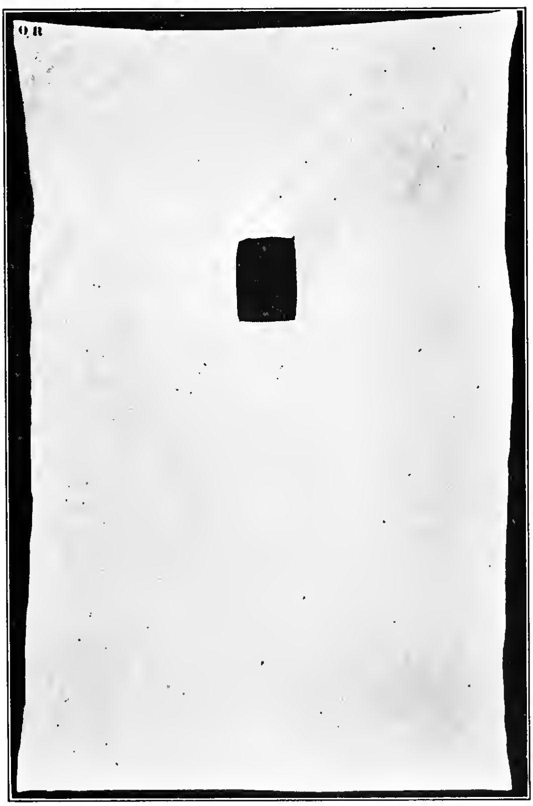


FIG. 44.—CELIOTOMY SHEET.

irrigation is taken up under operating-room technic (page 151).

The celiotomy sheet (Fig. 44) is a large oblong of cotton or muslin with a square opening near its center. It should be large enough to hang over the sides of the operating table, reaching almost to the floor, so that the lower portion of the operator's gown does not come in contact with the table (Fig. 121). Frequently during an operation the surgeon steps back from the operating table and allows his hand to come in contact with the gown below the waist. If this portion of the gown has come in contact with the side of the table, it is contaminated and the hands are also contaminated. This can be avoided by taking the precaution mentioned.

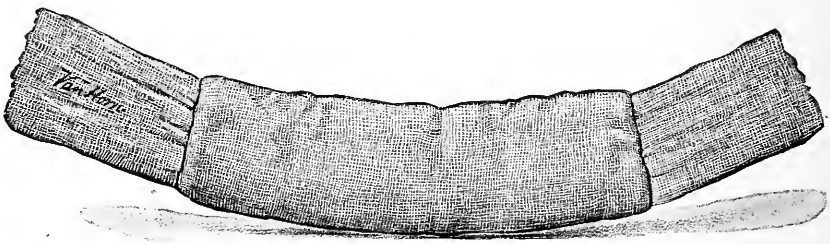


Fig. 45.—Vulvar Pad Used to Catch Vaginal Discharges.

The sheet is folded in a small area and sterilized under pressure. Its arrangement at the time of operation is described under operating-room technic. While the sheet shown is designed for abdominal operations it may be used in other situations. The principle being of isolating the part to be operated upon with sterile surroundings.

Rubber sheets are used to protect surrounding parts from moisture (Fig. 119). Duck suits and canvas shoes are described under attire of the surgeon (Figs. 75, 85).

Vulvar pads (Fig. 45) are placed against the vaginal outlet following operations in this region, and when vaginal drainage has been made following celiotomy. The pads are composed of gauze with several layers of absorbent cotton held between its layers.

CHAPTER IV

SUTURE AND LIGATURE MATERIAL

General considerations of absorbable and non-absorbable material.
Absorbable ligature material: Catgut: Plain catgut; sterilization of catgut, by biniodid of mercury, by heating in fatty liquid: Chromic catgut; sterilization of catgut with cumol: Iodin catgut—Kangaroo tendon.
Non-absorbable ligature material: Silk-worm gut—Silk—Pagenstecher thread —Horse hair—Silver and gold wire.

GENERAL CONSIDERATIONS OF ABSORBABLE AND NON-ABSORBABLE LIGATURE MATERIAL

The aim of suturing wounds is to hold tissue in apposition, until repair by cell genesis takes place. Sutures are not concerned directly in repair, they place the tissues in such relationship to each other as to make repair rapid and easy, but of themselves will not hold tissues together as a nail holds two boards or a bolt two pieces of metal in apposition. This consideration should be a plea against the strangulation of tissue, the outcome of tightly drawn stitches so frequently seen. The ideal suture is one which is sterile, non-irritating, is absorbed at the expiration of the time required for healing, and is of sufficient tensile strength to permit of the necessary manipulations without breaking asunder.

As a general proposition suture material which is absorbed should be employed in deep suturing. Material which it is necessary to ultimately remove may be employed in superficial repair. Dividing suture material into two classes—the one absorbable, the other non-absorbable—we may say that the latter is less apt to be a carrier of infection, on the simple and easily understood ground, that the quality which renders them resistant to the action of the circulating fluids in the body, also makes them uninfluenced by the manipulations necessary to complete sterilization.

In addition to this, the modification of consistence which an absorbable suture material undergoes in absorption, creates, at a certain time of the process, a condition favorable to infection. This obtains more readily in sutures a part of which lie on the skin, and would argue for the employment of non-absorbable suture material in this situation, a notion borne out by the facts as observed in practice.

The complications arising in the after-treatment of operative cases are commonly enough the outcome of disturbances caused by sutures and ligatures. These are taken up under a separate head (page 211).

The method of preparing suture material bears an important relationship to postoperative occurrences, and the technic of sterilization is extensively gone into in this connection for this reason.

Absorbable suture and ligature material: Catgut, kangaroo tendon.

Non-absorbable suture and ligature material: Silk, silk-worm gut, Pagenstecher thread, Silver and gold wire.

ABSORBABLE LIGATURE MATERIAL

CATGUT

Catgut, so-called, would be an ideal suture material were it not for the fact that it is difficult to sterilize. It is not, as the name implies, made from the intestine of the cat, but is taken from the small intestine of the sheep. It is obtainable in the market, dry and of varying thickness. The diameter of the product is designated by number, *i.e.*, 00, 0, 1, 2, and 3. This classification is somewhat arbitrary, and the diameter of the product is quite variable. However, but little acquaintance in a practical way renders it sufficiently accurate.

It is easy to see that the material composing the catgut is the natural habitat of bacteria. The bacteria exist throughout the entire thickness of the gut, and any method of sterilization to be effective involves the problem of penetration of its entire thickness by a process which does not destroy its tensile strength. The writer wishes to state that for general purposes, with perhaps the exception of large hospitals, suture and ligature material is best and most safely handled by commercial houses who make a specialty of preparing and sterilizing them.

The problem of sterilization of catgut is so complicated that, unless special apparatus and experience is employed, unfavorable and, indeed, at times fatal outcome obtains.

Two kinds of raw catgut are generally employed, the smooth and the rough.

Smooth catgut is of the best quality of imported (Germany) banjo and violin strings, put up in boxes containing thirty strings of each of the sizes.

Designation.	Average Length.	Average Breaking Point.
Banjo 1 (thinnest)	$67\frac{1}{2}$ in.	5 lbs.
Banjo 2	$67\frac{1}{2}$ in.	8 lbs.
Violin E	$67\frac{1}{2}$ in.	18 lbs.
Violin A	$44\frac{1}{2}$ in.	24 lbs.
Violin D (heaviest)	$44\frac{1}{2}$ in.	32 lbs.

The first three sizes are those mostly used in surgery. Each string is coiled or arranged in a manner shown in Fig. 46, and tied with a strand of silk. Colored silk colors the solutions used.

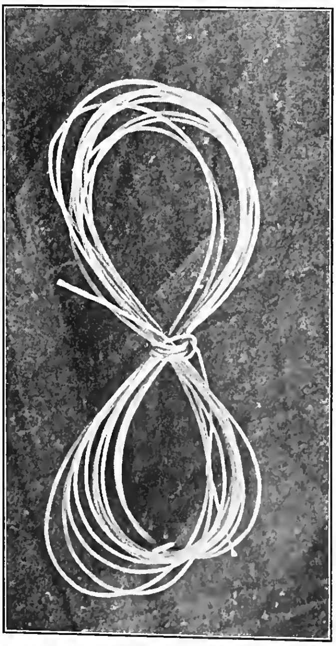


Fig. 46.—Catgut Looped and Ready for Sterilization.

Rough catgut is the kind which clockmakers and jewelers use. It comes in strings of five meters in length, of various sizes; 00, 0, 1, 2, and 3 are most commonly used. (*Bryant.*)

A large number of methods of preparing catgut for ligatures and sutures have been employed. None of these are effective unless carefully employed and accurately executed. Of all the methods the so-called cumol and dry sterilization is the most certain, and is universally applicable.

Three kinds of prepared catgut will be described: the plain, the chromicized, and the iodized. The former two necessitate the removal of the fats from the raw material, the latter does not.

Plain catgut is more readily absorbed than the chromic, is more pliable, and consequently ties a closer knot than chromic, though the latter is stronger, remains *in situ* longer, and is more readily handled. The exact place which iodin catgut occupies is difficult to state. In its preparation it frequently undergoes a change which lessens its tensile strength. This is a serious objection. It is most useful in hospital practice, where it is used soon after preparation. The simplicity of preparation is a strong factor as regards its field of usefulness. On the whole, the plain and chromic gut fill all wants, *i.e.,* if properly prepared.

Removal of Fats from Catgut.—A number of coils of gut 3 feet in length (Fig. 46) are placed in an Erlenmeyer flask and submerged in ether. Most manufacturers who prepare catgut for surgical use allow the material to lie in ether for a month, changing the ether bath at intervals, with the view of removing the fats held in solution, and substituting fresh ether which will permit of additional chemical action.

If sufficient facilities for this be not available, the flask containing the submerged gut is exposed to steam and the fats boiled out with ether. The top of the flask is connected with a condenser to save the vaporized ether. Care should be taken not to allow the open flame to come in contact with the ether vapor. The ether should be distilled before using a second time. The ether is poured off while hot, and the boiling should continue for one hour. Some fat will remain in the gut after the ether extraction is completed. This may be removed by boiling the gut in alcohol, preferably absolute alcohol, though the commercial 95 per cent. will serve the purpose. If the percentage of water in the alcohol is greater than 5 per cent., the moisture will cause the gut to swell up, tangle, and lose its tensile strength.

Sterilization of Catgut.—The destruction of bacteria in gut by chemical action, such as immersion in a solution of biniodid of mercury in chloroform, bichlorid of mercury in alcohol, etc., has been employed for many years and has given results which have seemed to be desirable. However, latterly the subject of catgut sterilization has been made the object of scientific investigation, which seems to show that chemical treatment of catgut does not achieve sterility. This has been shown by making cultures from raw gut, treating them with antiseptic solutions, such as are mentioned above, precipitating the antiseptic with the proper chemical agent, making cultures again, and noting the development of growths of pathogenic bacteria. Again, in several instances tetanus has developed as the outcome of using gut prepared by immersion in antiseptics. However, a number of surgeons regard the sterilization of catgut by the chloroform-biniodid method as efficient, and it is described here for that reason, though employment of the method is not advised by the writer.

Sterilization of catgut by a solution of biniodid of mercury is a simple method. After the gut has been subjected to ether extraction of the fats, it is at once transferred to a saturated solution of biniodid of mercury in chloroform, in which it is copiously submerged. The chloroform saturates at 1 in 1,000 of biniodid of mercury. The gut is stored, thus submerged, in a glass-stoppered jar (Fig. 48), and is ready for use. Sufficient quantity for immediate use is removed by means of a sterile dressing forceps, and the stopper is replaced. The glass container should not be left open during an operation, as an error is very likely to occur, the assistant being liable to use a fertilized instrument for the purpose.

It is true that a combination of chemical agents and heat will achieve the desired result, yet it is to be borne in mind that heat is the most reliable bactericidal agent.

The treatment of catgut with chemical agents should be destined to influence its pliability and tensile strength and to offset, as far as possible, the destructive effect of heat. It is just as fair to assume that a chemical agent of sufficient strength to destroy bacteria may also probably destroy the characteristics of the gut which make it of use. This is shown, in a way, in iodin catgut, which is sterile after being immersed in iodin solution, yet frequently is of no use at the time of the operation because of the destructive effect of the iodin when submerged for a considerable period of time.

Heating of Catgut in Fatty Liquid.—After extraction of fat and immersion in a solution of chloroform and biniodid, as stated, the gut is wound on bobbins (Fig. 47). Each bobbin holds several strands of three feet each. The bobbins, which are sterile, are put into a vessel, submerged in albolene, and heated over a petrolatum bath. The temperature is run up to 275° F., where it is maintained for fifteen minutes. The temperature is then allowed to fall and the gut on the bobbins returned to the chloroform and biniodid of mercury solution. This method is a good one, but does not permit of the raising of the temperature sufficiently high to enable one to be certain that all bacteria have been destroyed.

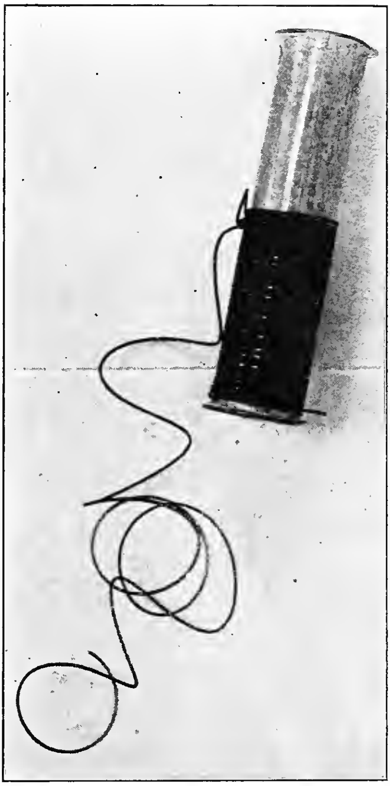


Fig. 47.—Catgut Wound on Bobbin, Ready for Use.

Chromicized Gut.—The fats are removed, as described above, and the gut is then wound on bobbins (Fig. 47) or arranged in coils (Fig. 46) and submerged in the following solution:

Potassium bichromate. $22\frac{1}{2}$ grs.
Distilled water....... 15 oz.

dissolve and add

Glycerin .... $2\frac{1}{2}$ drachms.
Carbolic acid..... $2\frac{1}{2}$ drachms.

The gut is allowed to remain in this solution during thirty hours. It is then removed and tightly stretched on a notched board and allowed to dry in the air or in an oven at a temperature of 113° F.

When the gut is dry, it is coiled again, and after being placed in a glass jar (Fig. 48), sterilized in alcohol vapor under pressure. The various sizes of catgut should be placed in separate jars, each labeled (Fig. 49) with the view of obviating confusion when the contents are to be used. The illustration shows a method of arrangement which is satisfactory in this connection.

The chemical treatment is destined to make the gut strong and hard, so as to be maintained in the tissues for varying periods without absorption. It does not sterilize the gut. Indeed, the hardness of the product makes the gut less readily sterilized. The exposure to alcohol vapor under pressure is expected to do this. The writer regards this as a quite universally useful method, but would replace the alcohol vapor sterilization with exposure to dry heat at a temperature of 250° F (see cumol method, page 92). Chromicized catgut is stiff and hard. To overcome this the gut, after being chromicized, has been subjected to the albolene boiling as described above. The same objection to the employment of this method applies in this connection.

Fig. 48. — Catgut Coils Submerged in a Solution of Biniodid of Mercury in Chloroform.

Sterilization of Catgut with Cumol.—The method here described is regarded by the writer as the safest, and if properly carried out, gives uniformly satisfactory results. It applies to both

Fig. 49.—Convenient Arrangement of Jars Containing Catgut for Immediate Use.

plain and chromic gut, for, of course, the latter is not sterilized by the process which chromicizes it.

The apparatus used for drying and cumolizing catgut is described as follows (Fig. 50): The sterilizer is made throughout of brass and bronze, nickel-plated. The interior, or cumol-retaining cylinder, is 6 inches in diameter and 8 inches deep. The outer cylinder is 8 inches in diameter and 8½ inches deep, providing for an intervening space of 1 inch all around between the two, and 1½ inches from the bottom of the outer cylinder. This space between the two cylinders is compactly filled with white sand. The top of the sterilizer articulates closely with the cast bronze "faced" ring secured to the upper end of the retaining cylinder, forming a steam-tight joint.

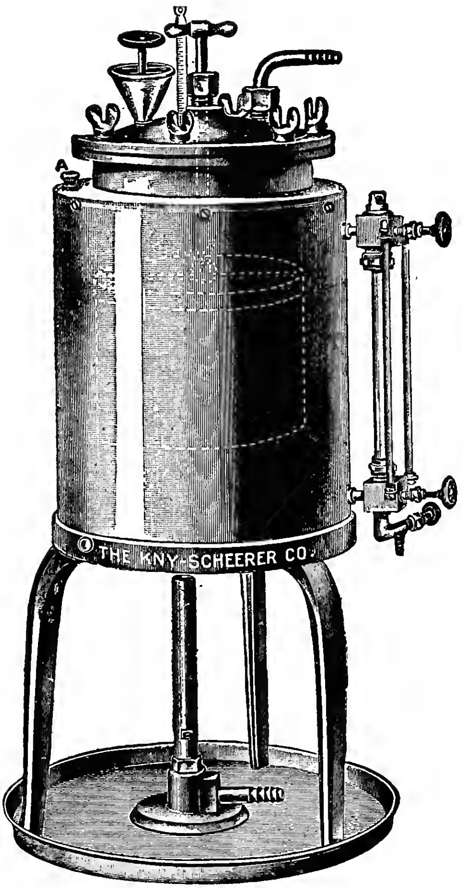


Fig. 50.—Apparatus for Sterilization of Catgut by the Cumol Method.

The apparatus is supported on four legs, which rest in a metal tray, as shown in the illustration. The heat is furnished by means of a Bunsen burner, though an alcohol flame or other source of heat may be used for the purpose. The heat is directed against the bottom of the outer cylinder, heating the quartz bath uniformly, and, in turn, transmitting uniform heat to the cumol. The cumol sterilizer is provided with a draw-off valve, thermometer, and a burner consistent with the fuel at disposal.

The gut is cleansed and the fats extracted in the way already described, cut into lengths of three feet and coiled (Fig. 47), then placed in the interior cylinder of the cumolizer (Fig. 50), and the apparatus closed. The temperature is raised to 80° C. and maintained there for two hours, at the end of which time all moisture is driven from the gut, thus preventing it from becoming brittle during the subsequent steps of its preparation, the result of conversion of the animal tissue into a glue-like substance.

The gut is then submerged in cumol, and the temperature raised to 155° C. and maintained for one hour. The cumol is then drawn off through a tube at least 24 inches in length attached to the lower spout (Fig. 50), and the rest of the cumol driven off by maintaining a temperature of 100° C. for about two hours.

The gut is then removed and stored in either glass tubes or jars (Fig. 49). The gut in the jars is covered with a solution of mercuric biniodid, 1 in 1,000. The latter precaution is taken to prevent contamination of the gut when removing a portion of the contents of the jar.

The objection to storing sterilized catgut in jars, for fear of subsequent contamination, has been overcome by placing the prepared suture and ligature material in hermetically sealed glass tubes. The gut is coiled or wound on a metal bobbin, placed in the glass tube, and after being sterilized in cumol, as described, at a temperature of 300° F. for two hours, the tube is sealed and resterilized for one hour at 18 lbs., in a steam pressure sterilizer (Fig. 21). This is an ideal way of handling catgut.

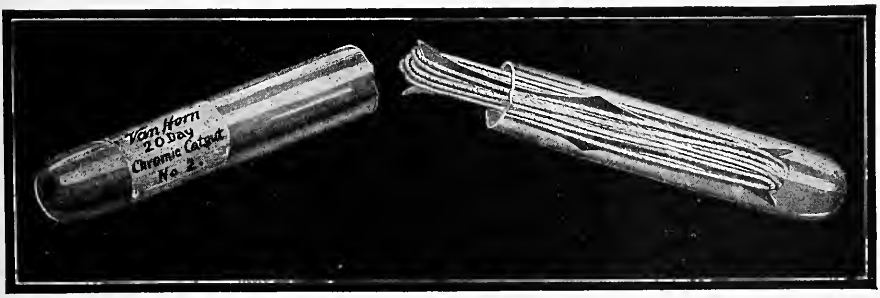


FIG. 51.—STERILE CATGUT IN HERMETICALLY SEALED GLASS TUBES. Tube broken at file scratch.

The glass tube is scratched with a file mark near its middle, and when the tube is opened it is readily broken at this point (Fig. 51). A sterile towel should be used for the purpose to prevent injury from the broken glass to the surgeon's fingers. In this way contamination of the material during transportation is made impossible, and it is only necessary to sterilize the outside of the tube at the time of the operation.

The latter object is attained by sterilization by boiling simultaneously with the instruments, or by submerging the sealed tube in a solution of bichlorid of mercury for an hour before opening it, in the manner stated.

When the gut is in the glass tube, the solution in which it is submerged magnifies its diameter. To obviate error with respect to the size when removed from its sterile container, each tube should contain a small label registering its size, thus preventing annoying delay and, indeed, unnecessary waste of material. A label affixed to the surface of the tube would not fill the purpose, for the obvious reason that it would come off during either the heat or chemical sterilization of the tube.

As a rule, Number 2 catgut is the most widely employed. Number 2 plain gut is generally employed for ligature of bleeding vessels divided during operation. Plain gut, as a rule, should be employed for ligature of pedicles and the omentum. The chromic gut is too hard, does not allow of a tight knot, and is liable to slip. Number 3 is as large as is ever necessary for the purpose of deligating tissues.

On the whole, it may be said that the smaller the gut the less is the liability of infection, as the finer kind is, as can easily be seen, more readily sterilized than the heavier. In a given case it would be better to use several strands of finer gut than one heavy strand, for the same reason. The Number 1 may be used for tying smaller vessels and the 0 and 00 for apposition of wounds where cosmetic effect is a consideration, such as in the face, neck, and hands.

Chromic gut is employed where apposition is to be maintained for a considerable period of time. Muscle fibers which have been divided should be held in place with chromic gut, though it will rarely be necessary to use heavier than Number 3. Catgut in the skin is unreliable, though chromic gut gives better results than the plain in this situation. The writer has abandoned the use of catgut in the skin, and uses silk-worm gut where cosmetic effect need not be considered, and horsehair on the face. The question of kind of suture to be used in a given portion of the body will be taken up under the head of suturing of wounds (page 211).

In this connection, mention may be made of the simultaneous sterilization of a suture and needle for emergencies. The suture material, as has been seen, is readily rendered sterile, but when an emergency arises, a sterile needle is not always available. To meet this contingency, a suture is threaded on a needle and placed in a glass tube, which is then sterilized in the manner stated in connection with sterilization of catgut (page 94). It is only

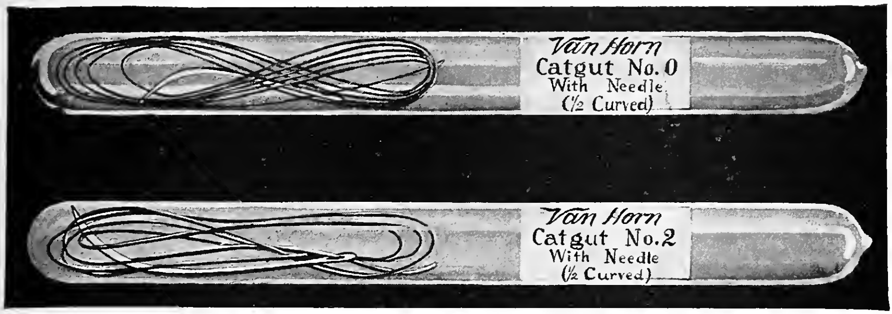


FIG. 52.—EMERGENCY SUTURES WITH NEEDLE (½ CURVED) IN HERMETICALLY SEALED TUBES.

necessary to break the incasing glass tube to have the little appliance at the disposition of the surgeon.

The method is, of course, available for suture material other than catgut, in which instances the sterilization and preservation is carried out in accord with the means employed for sterilization of the particular kind of suture material used.

Iodin Catgut.—Theoretically, iodin catgut is sterilized by the iodin it is soaked in, and as it is absorbed, destroys whatever bacteria may come in contact with it from extrinsic causes during absorption. Unfortunately, the chemical action of the iodin destroys the tensile strength of the gut at the expiration of a certain period of time. However, if the gut is used in large quantities, as obtains in hospital practice, the iodin sterilization and preservation is an exceedingly useful method. The gut, when treated in this way, is pliable and easily handled, and, indeed, if the objection stated could be removed with certainty, would be an ideal ligature and suture material. The raw gut is used for the purpose; neither the ether nor alcohol bath is necessary.

The gut is rolled on glass spools (Fig. 47) (when fashioned into coils it is believed to rot more rapidly) and immersed in the following solution:

Iodin	1	per cent.
Potassium iodid	1	per cent.
Sterile water	98	per cent.

The gut is allowed to remain in the solution for eight days, when it is ready for use. As a rule it is preserved in a glass jar (Fig. 48), though it may be put in tubes and covered with the solution mentioned. (Fig. 51.)

If iodin catgut is preserved in a sealed glass tube, the latter must be sterilized in cold antiseptic solution just before using. If the tubes are boiled with the instruments, the catgut is disintegrated, becomes friable, and is useless. The theory of impregnating catgut with iodin is that, as the gut is absorbed, the iodin chemically combats accidental infection. Theoretically, this looks rational, yet experience has not quite sustained this view.

KANGAROO TENDON

Kangaroo tendon, as its name implies, is made from the tendon of the kangaroo. It will not stand heat and must be sterilized by immersion in antiseptic fluids. It is not, however, the natural habitat of bacteria, as is catgut, and is rendered sterile without heat. Its preparation is simple. The tendon is extracted with ether, which removes the fats, immersed in a mixture of albolene

Fig. 53.—Kangaroo Tendon Sutures in Hermetically Sealed Glass Tube.

and camphor 3 per cent., containing mercuric bichlorid 1 in 4,000, in which it is soaked for a week. It is then put in glass tubes (Fig. 53), submerged in fresh bichlorid and albolene mixture, the tube sealed and sterilized in cold bichlorid of mercury solution just before use. It must be borne in mind that it must not be boiled with the instruments.

Kangaroo tendon is used where prolonged immobilization of traumatized parts is indicated, such as holding the fragments of fractured bones in place, for suturing fractured patella, and the like. It may be obtained in the market in so-called large, medium, and small sizes. The large size is used to hold fragments of bones in apposition and the medium and small for the same purpose as regards ruptured tendons.

It is slowly absorbed, and at times, in cases in which the heavier grade has been used, requires removal because of its persistence in the tissues. It is used (small size) in herniotomy for radical cure.

On the whole, its field of actual usefulness is small, the probabilities being that it possesses no advantage over properly prepared chromic gut in its application to soft parts and none beyond silver wire with respect to maintaining apposition of bones.

NON-ABSORBABLE LIGATURE MATERIAL

SILK-WORM GUT

Fig. 54.—Silk-worm Gut in Hank.

Silk-worm gut is the fiber drawn from the body of the silk worm killed just as it is ready to spin its cocoon. It is smoother than silk and is more easily cleansed. It is obtainable in the market in hanks about fourteen inches in length (Fig. 54). It can be boiled without damage and is sterilized by boiling. The simplicity of the measure for rendering it sterile recommends its use when indicated.

It is used most frequently in the skin, and being of small diameter, it leaves only small stitch-hole scars. It is not absorbed and must be removed when healing has taken place. Its whitish color renders it difficult to see after it has been *in situ* for a time, more especially if the stitches are buried in the slight crust which covers the line of incision. This has been overcome by dyeing the silk-worm gut black. It is thus more readily found, and removed with less disturbance to the patient, a desirable, if not essential, refinement in surgical technic. For immediate use the gut is stored, after boiling, in glass tubes, submerged in a solution of bichlorid of mercury, 1 in 2,000, in 70 per cent. alcohol (Fig. 55). About six sutures are placed in a single tube.

This suture is a desirable one for office use, especially in manu-

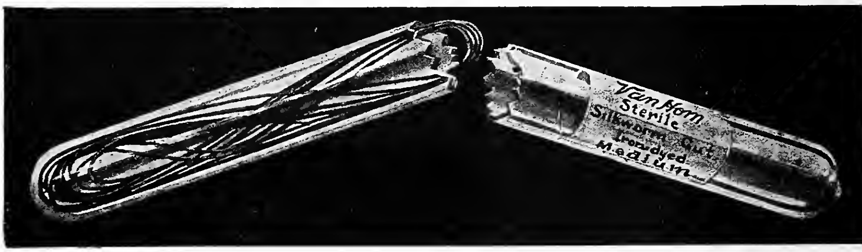


Fig. 55.—Iron-dyed Silk-worm Gut in Glass Tube.

facturing towns where the surgeon is called upon to make repair of trauma in his office at short notice.

The finer grades are intended to take the place of horsehair. However, very fine silk-worm gut is not as easily handled as the stiffer horsehair, which still holds its place as an exceedingly useful suture material, where accurate coaptation of wounds is necessary.

It is the experience of the writer that stitch abscess occurs less frequently when silk-worm gut is used in the skin than with any other suture material. Its field of usefulness is only that of a suture; it is of no value as a ligature for obvious reasons, the most determining of which is the fact that it cannot, because of its stiffness, be tied in a close knot.

SILK

Silk for suture and ligature is obtainable in the market in two forms, twisted and braided. The twisted is used for finer sutures and the braided for retention suture and ligature of large pedicles. Its advantages are that it is readily sterilized, easily applied, and remains firmly tied. It is, however, readily infected and is not absorbed. Silk is sterilized by boiling for ten minutes in a 1 per cent. aqueous solution of sodium carbonate.

Haegler seems to have shown that sterilization of silk by heat is not sufficient, claiming that the drawing of the material through the hands and the manipulations necessary to threading it on needles cause reinfection. Of course this is true of all suture and ligature material. It would, perhaps, be fairer to say that silk, because of its nature, is more readily infected during manipulation than the smoother suture materials, a conception which seems rational. However, if the silk is boiled immediately before an operation, it will be sterile, and, indeed, it is suggested that silk be kept wound on the cardboard as it comes from the manufacturer (Fig. 56) and boiled with the instruments, rather than sterilized in soda solution and then preserved, wound on bobbins, in antiseptic solution. However, if the surgeon insist that sterile silk be constantly available, the indications may be met, as done by *Kocher*.

Fig. 56.—Surgeons Silk Wound on Cardboard.

The silk is treated for twelve hours with ether and alcohol to extract the fats. It is then boiled for ten minutes in a 1-1,000 solution of bichlorid of mercury, and rolled on sterile glass spools (Fig. 57), after the hands have been cleansed and incased in rubber gloves. The spools of silk are then again boiled in a 1-1,000 bichlorid of mercury solution. Various sizes of silk may be arranged on spools in a glass jar arranged as shown in Fig. 58, a very convenient method of handling the material. The albumin of the silk forms a chemical union with the mercury, which is slowly extracted by the fluids of the circulation in the body. The mercury gradually disappears from the suture in from five to ten days. *Haegler* does not believe that the small amount of mercury present in the suture destroys bacteria, but checks their growth.

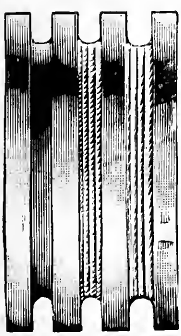


Fig. 57.—Silk on Spools. (Bryant.)

Silk, on general principle, should not be used for ligatures or buried sutures. It is being less and less used as the art of preparing absorbable suture material becomes perfected.

It has a distinct field of usefulness in intestinal surgery. For this purpose, a very fine grade of silk is used, and should be dyed black so as to permit of closer scrutiny when being placed *in situ*. The operative field is apt to be bloody, and white silk soon takes on the color of the medium in which it is being used. If a reliable absorbable suture material of sufficient tensile strength and as great pliability as silk were devised, an ideal intestinal suture would be achieved.

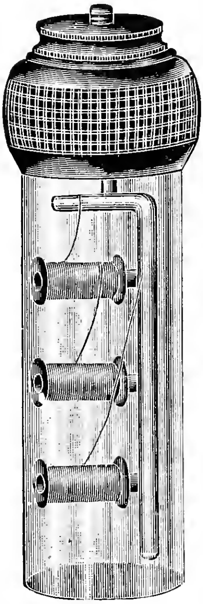


Fig. 58. — Wide-mouthed Bottle for Ligatures. (Bryant.)

Silk is being used for deligating large pedicles and the broad ligament in salpingectomy. It should never be used for the latter purpose, and but rarely for the former. Silk sutures or ligatures, while they, more especially in regard to the latter, give the surgeon a feeling of security as to the permanency of the knot, give rise to adhesions, because of the prolonged irritation common to all foreign bodies in the tissues, and not infrequently they are the causative factor in intestinal obstruction following celiotomy. In intestinal suturing the area of exposed suture is so small as to be perhaps a minor factor in this connection, yet non-absorbable suture material in closed cavities is never as desirable an agent for repair as the kind which is taken up by the circulating fluid.

For operations in private practice silk may be preserved in glass tubes. The braided (Fig. 59) and the twisted (Fig. 60) are both put up in this way.

PAGENSTECHER THREAD

Pagenstecher thread is a linen thread which has been dipped in a solution of celluloid. It is readily obtained in the market in skeins. (Fig. 61.) It is strong, of small diameter, is readily rendered sterile, and is easily handled. It does not lose its slight stiffness when soaked in solutions, and consequently does not ravel as does silk when wet. It is destined to displace silk for intestinal work. The only objection to its use is that it is not absorbed. It is sterilized by boiling, and may be boiled for a practically indefinite period of time without being damaged. Like anything

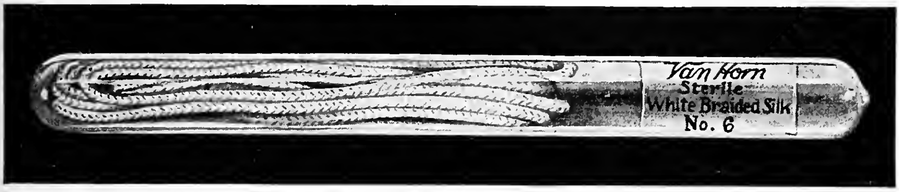


Fig. 59.—Braided White Silk in Hermetically Sealed Glass Tube.

which will stand heat, it is, of course, absolutely sterile after boiling.

It may be boiled and preserved, like silk, in a glass jar (Fig. 48) or glass tubes (Fig. 59) submerged in bichlorid of mercury

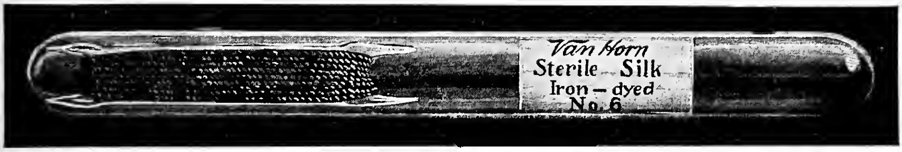


Fig. 60.—Twisted Iron-dyed Silk in Hermetically Sealed Glass Tube.

solution, 1-1,000, or placed in alcohol. It is advised that it be boiled with the instruments immediately before operating. Twenty minutes of boiling in a 1 per cent. solution of sodium carbonate is sufficient for the purpose.

Fig. 61.—Pagenstecher Thread.

Its use is especially indicated in gastroenterostomy by sewing only, and in entroenterostomy where a long, continuous suture is employed. The large number of punctures made during the sewing, each time drawing the suture through tissues, is likely to weaken silk at a given point and just as the suturing is about completed the suture breaks. This necessitates a replacement of the entire suture, a very undesirable accident. The greater strength of the *Pagenstecher* thread renders this occurrence exceedingly unlikely. This feeling of security on the part of the surgeon engenders a certain complacency which is not disagreeable. On the whole, the *Pagenstecher* thread is an exceedingly valuable material for the purpose mentioned.

HORSE HAIR

Horse hair is used for apposing wounds of the face and neck where cosmetic effect is an important consideration. It is also used in repairing hare lip. The hair is extracted from the tail of the horse, is washed in soap and water, and boiled for an hour in 95 per cent. alcohol, when it is ready for use. It can be preserved in a glass jar (Fig. 48) or glass tubes (Fig. 59) submerged in alcohol.

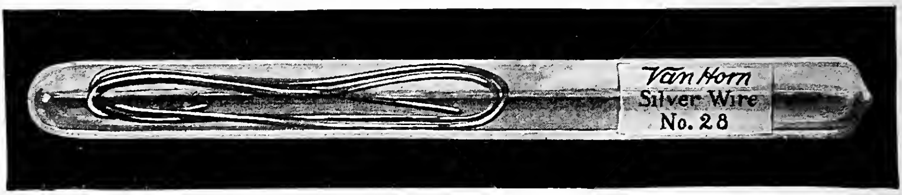


Fig. 62.—Silver Wire in Hermetically Sealed Glass Tube.

It is very easily handled, does not ravel, and because of its fineness may be threaded on exceedingly small needles. The latter qualification means small and, at times, quite invisible stitch-hole scars. Its black color renders it easily located when about to be removed.

SILVER AND GOLD WIRE

Silver and Gold wire are used to hold in apposition fragments of bone. Silver wire is most commonly used for the purpose. It has, on occasions, been used to hold soft parts in apposition, such as the cervix uteri after trachelorrhaphy, and as a deep suture following plastic repair of the female perineum. Other material has, however, taken its place in almost all instances except for the purpose of holding together divided bones. Gold wire is at times used in plastic repair of the nose.

Silver wire is, of course, readily sterilized by boiling. Twenty minutes of boiling in a soda solution, such as is used for sterilizing instruments, is sufficient to achieve the purpose.

It is, perhaps, at times found convenient to preserve the wire in much the same manner as silk-worm gut. In these instances it may, after boiling, be placed in hermetically sealed glass tubes (Fig. 62) and treated as this class of vehicles all are, immediately before the operation.

CHAPTER V

WATER AND CLEANSING SOLUTIONS

Water: Sterilization of water—Apparatus for sterilization of water—Outfit for sterilization—Handling of water during operations.
Antiseptic Solutions: Carbolic acid—Mercury—Zinc chlorid, etc.—Thiersh's fluid—Peroxid of hydrogen—Plain sterile water—Saline solution.

WATER

STERILIZATION OF WATER

Absolutely sterile water is a necessity in operative technic. It is obtained with greater difficulty than would appear. Chemically pure water for lavage and cleansing is not a necessity, though when water is to be used to hold chemical agents in solution it had best be chemically pure to obviate chemical precipitation and, perchance, the introduction into wounds or the circulation of insoluble chemical agents which may act as foreign bodies.

Water in which all microörganisms are destroyed in the vessel from which it is drawn for immediate use achieves this object. All other methods of sterilization are faulty.

Distilled water has the advantage of being transparent, though the apparatus necessary for distillation is not readily kept sterile, and the simple distillation of water is not sufficient for the purpose of sterilization.

Muddy water may be sterile, though the foreign bodies may be removed by filtration, and, indeed, should be. However, in an emergency it would be wiser to use cloudy sterilized water than to act on the notion that, because water is clear, it is clean. Where water is used to fill cavities for examination, such as in cystoscopy, distilled and sterilized water is advantageous. In large hospitals and institutions distilling plants are installed and a large quantity of distilled water is constantly available. If this be sterilized it is of signal service for surgical purposes.

APPARATUS FOR STERILIZATION OF WATER

For the purpose of sterilizing water two kinds of apparatus are available. A, one which sterilizes water at the boiling point, 212° F., and B, one which sterilizes water at a temperature higher than the boiling point. The latter is the more certainly effectual.

For ordinary purposes, in minor or emergency surgery, water boiled in a clean vessel for twenty minutes and used immediately is practically sterile. Indeed, a tin kitchen boiler placed on a gas stove and the contents boiled as stated will answer the purpose. However, for office work and in smaller institutions and dispensaries, the apparatuses shown in Figs. 63 and 64 are recommended.

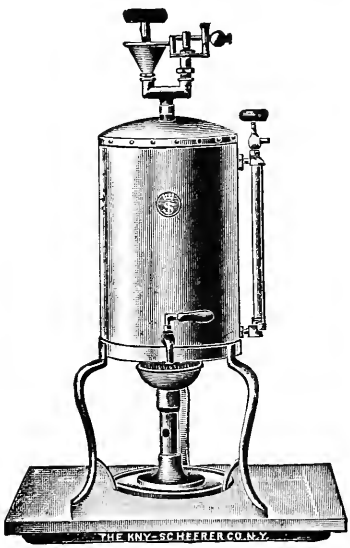


Fig. 63.—Apparatus for Sterilizing Water under Pressure, for Use in Surgeon's Office or Small Dispensary.

Fig. 63 shows an apparatus exceedingly useful for physician's office use, more especially for the genito-urinary cases. The apparatus sterilizes the water absolutely and is constructed to withstand pressure of 50 pounds to the square inch. To fill, the water is poured into the funnel and the quantity noted on the water gauge. The burner beneath is then lighted and the water heated until steam issues from the funnel, when the valve is screwed down. Sufficient steam pressure will then be generated to blow off safety valve which is set at 15 pounds or 250° F. This temperature is maintained for fifteen to twenty minutes for absolute sterilization. The capacity of the apparatus should be about two gallons.

Fig. 64 shows an apparatus similar to Fig. 63, except that the water is not subjected to pressure. If the contents be heated to boiling for twenty minutes, the water is practically sterile, but this apparatus is not so certain in its results as the former (Fig. 63).

The objection to the steam pressure sterilizer (Fig. 63) is that the water is liable to be either too hot or too cold when about to be used. This is obviated in the apparatus shown in Fig. 65 by a coil within the tank, which may be connected with the cold water tap. In this way the temperature of the water may be modified, its range being indicated by a thermometer affixed to the apparatus. This apparatus is devised for office use and answers the purpose very well.

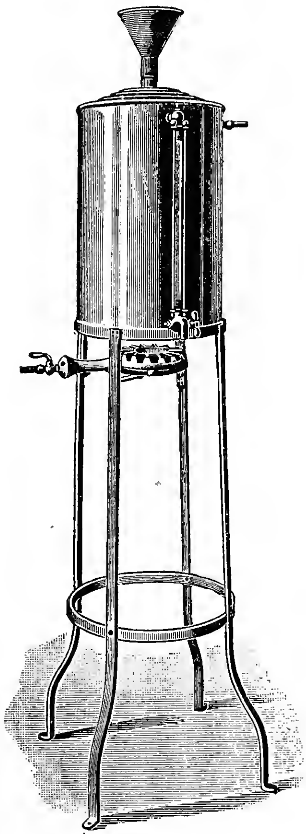


Fig. 64. — Water Sterilizer Suitable for Emergency Service.

Neither of these apparatuses permits sufficient elasticity with respect to the adjustment of the temperature of water, which is essential to the best possible work. The contingencies met in operative work are well met by the apparatus shown in Figs. 65 and 66.

The hydrant water supply is directly connected to filter M at point E. The filter itself consists of a natural porous stone bougie which can be taken out of the metal mantle for purpose of cleaning and be placed back into position by releasing top, which is held tight to cylinder by a heavy metal clamp N.

There are two outlets F F for the filtered water leading into the two tanks; both are provided with a valve. These valves may both be opened at the same time, or one tank may be filled first and then the other. As soon as the gauge glasses K K on the sides of tanks indicate that the latter are filled as far as gauge glasses register, the water has to be turned off by closing the respective valves leading from filter to tank. When both tanks are filled, first shut off water supply valve E leading to filter, and then close valves F F leading from filter to tanks.

The heating of the water in the tanks is now begun. The steam pressure safety valve W, on dome top of tanks, is always set at 15 pounds pressure, and as soon as this point is reached it will blow off steam and maintain a boiling temperature of 250° F., the equivalent of 15 pounds steam pressure. Water has to be kept at this boiling point for from twenty to thirty minutes, whereupon the gas or petroleum heaters G G have to be turned

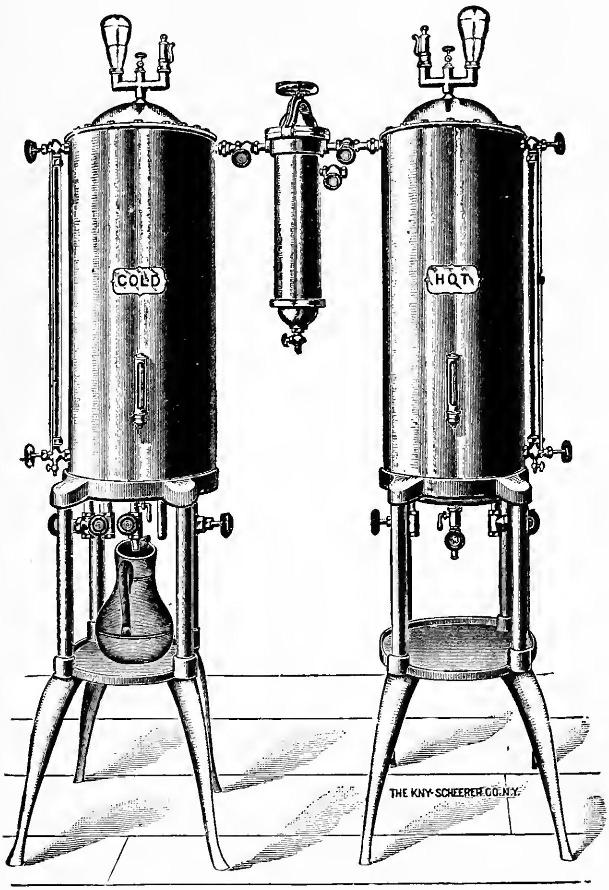


Fig. 65.—Apparatus for Sterilizing and Cooling Sterile Water under Pressure, for Use in Hospitals and Large Dispensaries.

out or, in the case of steam-heated apparatus, the high-pressure boiler steam be shut off by closing valves A A and B B.

Contents of the tanks can now be considered absolutely sterile, but the water is too hot to be available for immediate use. In order to facilitate an instantaneous cooling of the hot sterilized water, a cooling coil has been arranged in one of tanks marked

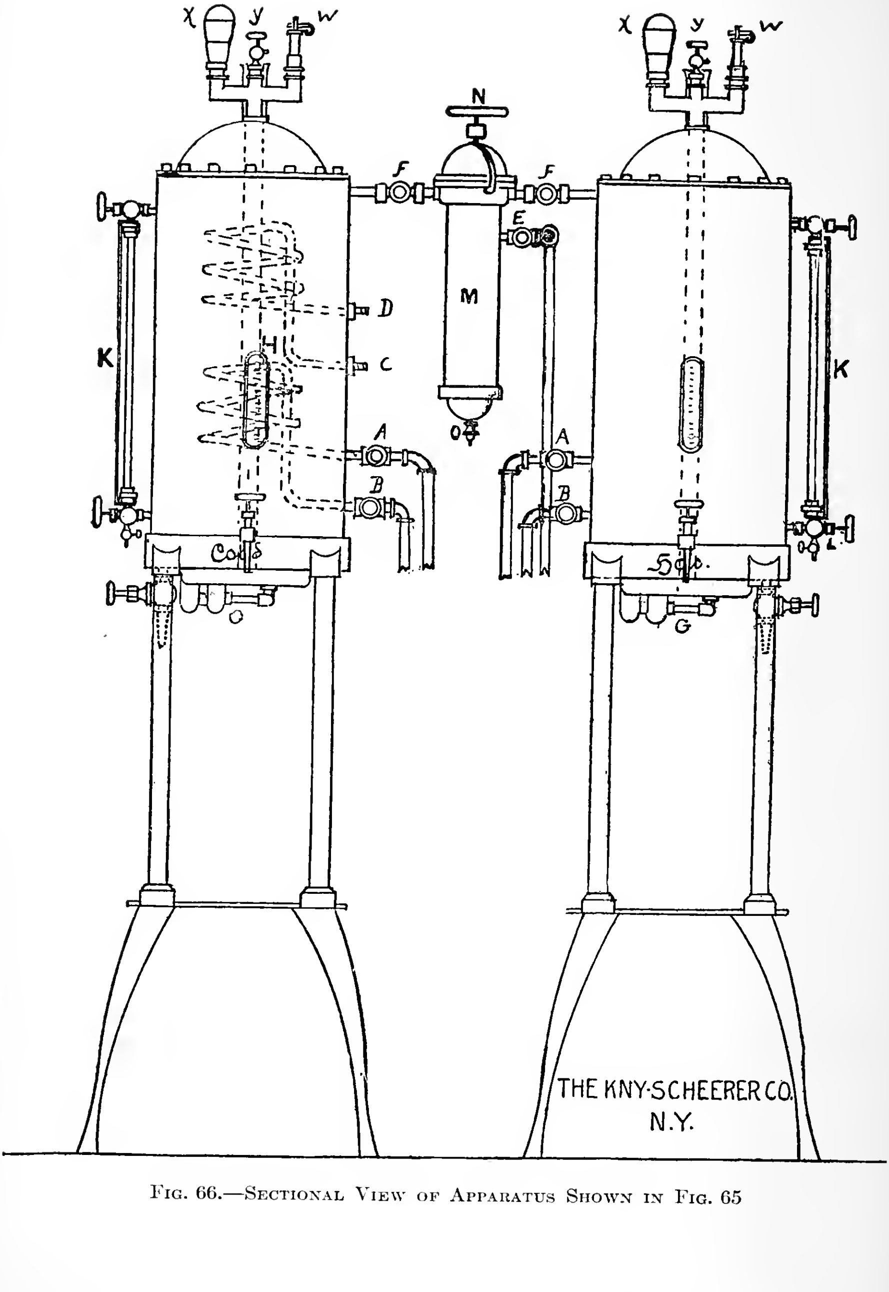


FIG. 66.—SECTIONAL VIEW OF APPARATUS SHOWN IN FIG. 65

"COLD" (Fig. 65). It consists of a heavily tinned copper coil, placed in the upper part of the tanks, into which is turned a flow of cold hydrant water, by admitting water at point D and providing for water off-flow at point C. Within from ten to twenty minutes the boiling-hot sterile water in the cylinder marked "COLD" will have been cooled down to within a few degrees above that of the hydrant water used for cooling. The sterilized water contained in this tank can be used immediately and be tapped by faucet in front. Water and container both are strictly sterile, and to maintain this state of absolute sterility, an air-filtering valve XX, filled with absorbent cotton is placed on dome top of each tank. As water is drawn out of tanks, the air enters the latter through the bacteriological filter X, the absorbent cotton in which should be renewed frequently.

Tank marked "HOT" (Fig. 65) has no cooling coil, but its contents are allowed to gradually cool down. By drawing from both tanks, sterile water of any desired degree of temperature can be obtained by mixing. If temperature of sterilized water should become too low, the heating medium may be started to raise it to the desired point, which can be controlled by consulting a thermometer H in front of each tank, and accordingly regulating heat supply.

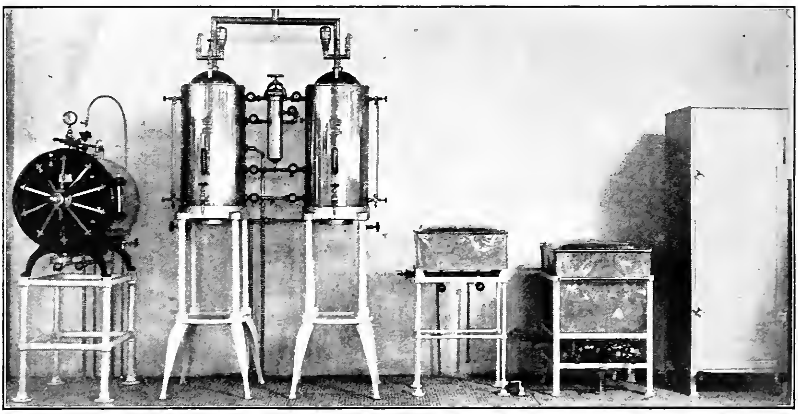
Attention has already been called to the fact that hydrant water, even though it may be crystal clear after passing through the filter, will become cloudy when being boiled under high temperature. Gradually the cloudiness will form precipitates which settle on the bottom of the tank. To draw off these precipitates a faucet is provided, flush with the lowest point in bottom of the cylinder, while the draw-off cock for sterile water for surgical purposes in front of the tank is about two inches above bottom.

To clean the sterilizer tanks thoroughly (which should be done every three months), remove filtering stone from metal jacket M, fill the latter with sal soda and proceed exactly as if you were sterilizing water. The tanks should then be emptied while under pressure by opening the flushing valves under the tanks.

Special attention is drawn to the fact that safety valves W W are always set at 15 pounds pressure per square inch when the sterilizers are ready for use. They should never be tampered with by inexperienced hands, as by tightening the set screws the amount of steam pressure in tank may be increased beyond the point of safety.

OUTFIT FOR STERILIZATION

Fig. 67 shows a plan of installing a complete sterilizing plant, as is employed in a large hospital. The outfit consists of a dressing sterilizer A, a water sterilizer B, an instrument sterilizer C, an utensil sterilizer for the purpose of subjecting to steam pressure pans, basins, irrigation containers, etc., D, and a blanket warmer E.



A *B* *C* *D* *E*

Fig. 67.—Complete Sterilizing Outfit Assembled for Use in Large Hospital.

This plan provides for the necessary heat to be drawn from either the steam power plant of the building or from gas Bunsen burners attached directly to the various apparatuses. The former plan is effective, and the necessary temperature is quickly available. However, the fact that steam power plants are rarely installed in duplicate, even in the largest hospitals, and that at times the boilers are shut down for repair and cleansing, suggests that the direct heating plan has its redeeming features. Also, the necessity of leading the steam through the hospital building during the summer months is objectionable, especially in regions where the climate is very warm. If feasible, the plant should be set up in a room adjoining the operating room, with the view of obviating the enervating influence of excessive temperature upon the patient and the surgeon during operations.

As stated farther on, the instrument and utensil sterilizer may be placed in the operating room, so that immediate sterilization of appliances during the operation is possible without the necessity for the assistant in charge of this portion of the work leaving the zone of operation.

The sterile water tanks are readily connected with the operating room by piping the outlets through the partition separating the chamber used for the purpose from the operating room.

The utensil sterilizer, instrument sterilizer, and the dressing sterilizer are described under separate heads.

Fig. 68 shows a diagrammatic scheme of the water, instrument,

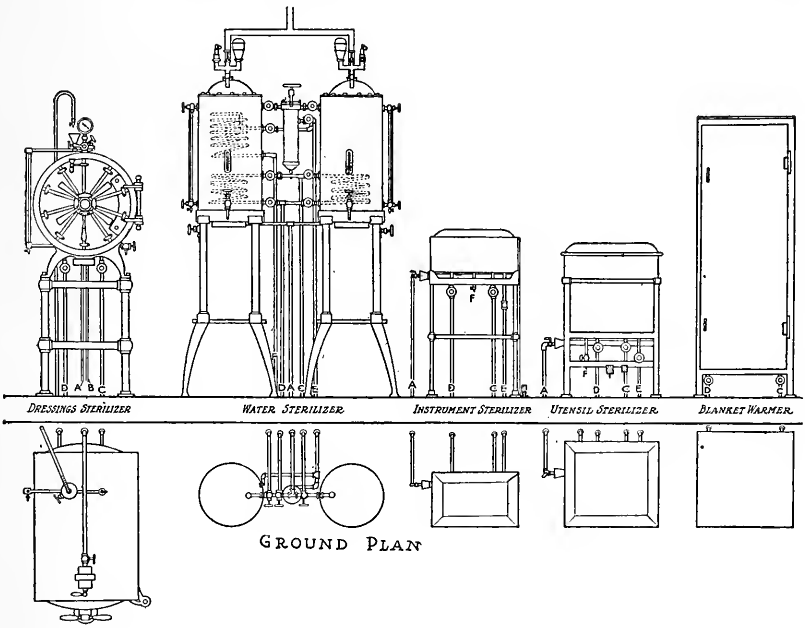


FIG. 68.—PLAN OF STERILIZING PLANT FOR USE IN LARGE HOSPITALS.

utensil sterilizer and blanket warmer. The upper diagram shows the plant in profile section, the lower in transverse section. This plant is arranged for obtaining heat from either the steam power plant or from gas Bunsen burners. This arrangement is very desirable, overcoming, as it does, the objections to employment of the single source of heat mentioned above.

This plant is an elaborate one, and has a large field of usefulness. It illustrates the principle involved, and in instances where this refinement is not available, forms the basis of modifi-

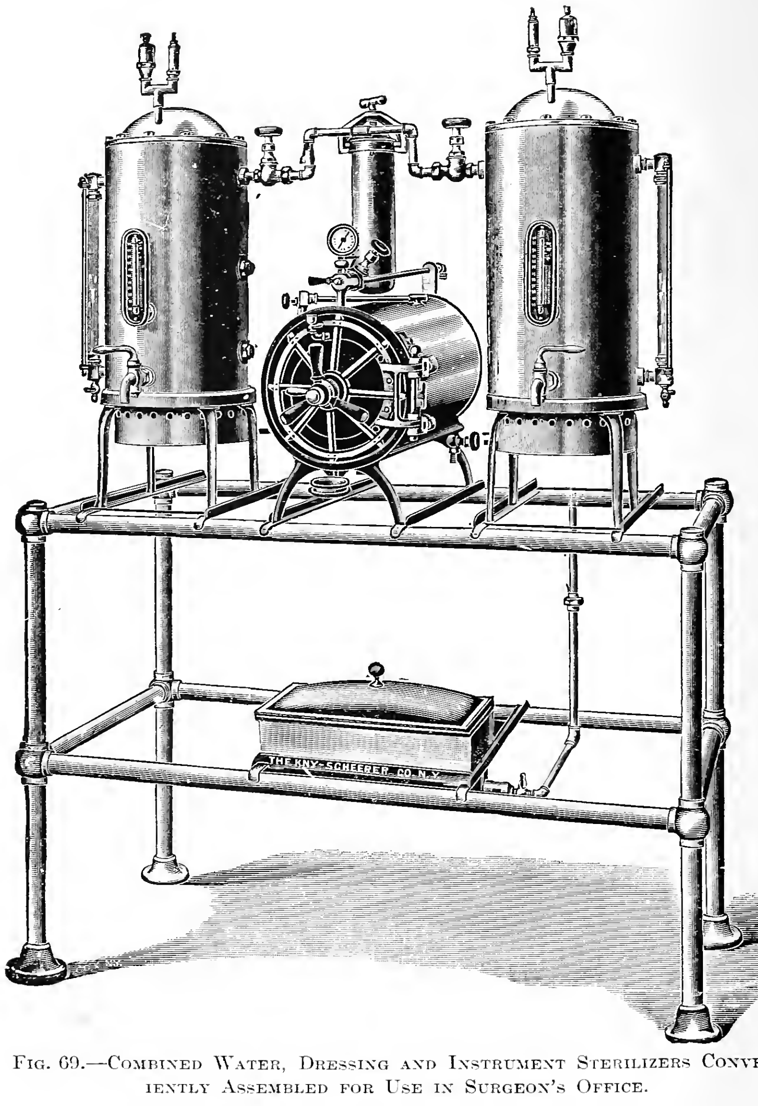


FIG. 69.—COMBINED WATER, DRESSING AND INSTRUMENT STERILIZERS CONVENIENTLY ASSEMBLED FOR USE IN SURGEON'S OFFICE.

cations in detail which may be necessary as the outcome of circumstances.

For use in the surgeon's office the outfit shown in Fig. 69 is very useful. It is in all respects similar to that described with

Fig. 70.—Convenient Arrangement of Pitchers Containing Sterile Water and Solutions for Use During the Operation.

regard to the dressing, water, and instrument sterilizers, except that it is arranged on a stand to conserve space and subserve availability. In this connection it is proper to state, as applies also to the hospital outfit, that modification of apparatus is permissible, provided the principles involved are adhered to.

The water tanks are arranged to sterilize the contents in each tank, one of which is fitted with the cooling coil (Fig. 66). Each tank has a capacity of about six gallons, and the dressing sterilizer is of sufficient capacity to sterilize at one sitting enough material to suffice for a single major operation, or enough

Fig. 71.—Method of Handling Sterile Water or Solution in Pitcher without Contaminating Contents.

sponges, towels, gauze, etc., for office use for several days. The instrument boiler is 8 inches wide, 6 inches deep, and 15 inches in length, giving an internal capacity sufficient for all practical purposes.

HANDLING OF WATER DURING OPERATIONS

Water is handled during operations by the non-sterile nurse or attendant. Whatever the apparatus employed for sterilizing

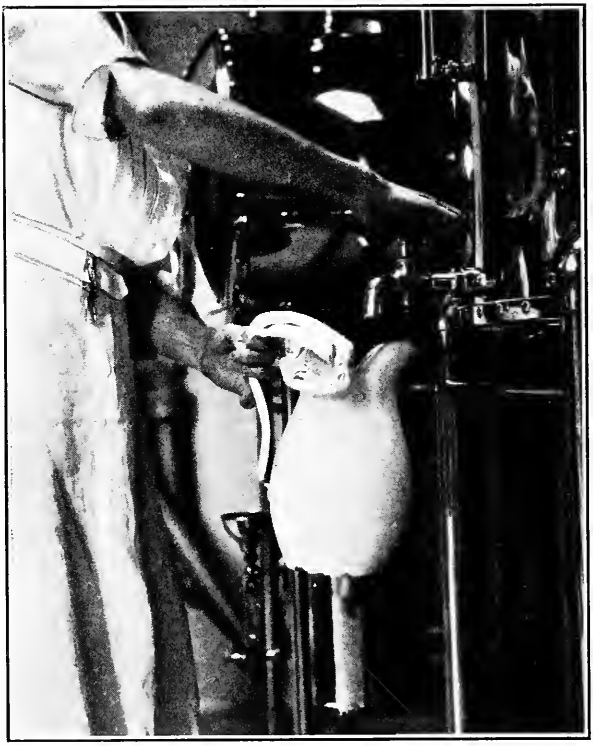


FIG. 72.—DRAWING STERILE WATER WITHOUT RISK OF CONTAMINATION.

water for surgical purposes may be, be it either a tin wash boiler, a basin, or an elaborate plant, such as described, it is essential to avoid contamination during transportation from the receptacle used to the wound.

The attendant who handles sterile material during an operation cannot safely handle pitchers, irrigators, etc., and although this matter is taken up under operating-room technic, attention is called to it in this connection. Perhaps the most desirable and elastic method of handling water is in pitchers. The pitchers are sterilized by boiling (page 151), and arranged on a table of convenient size. It is preferable to have available three pitchers of white enamel for the purpose, the larger two for pouring the

FIG. 73.—WRONG WAY TO HOLD BASIN CONTAINING STERILE WATER OR SOLUTION.

contents on the field of operation, and the second, a somewhat smaller one, for replenishing the larger two. The larger ones should hold a gallon, and the smaller half that quantity.

A convenient arrangement of pitchers is shown in Fig. 70. It will be seen that each pitcher is covered with a sterile towel fastened to the handle of the pitcher, and has a safety pin attached at the lip side of the pitcher. In order to fill the vessel, the nurse takes the pitcher by the handle, grasps the safety pin with the other hand (Fig. 71), and throws the towel back over the hand on the handle. The hand released from the safety pin now turns the faucet of the water tank, and the pitcher is filled. At no time do the hands come in contact with the water or with

Fig. 74.—Proper Way of Holding Basin with Sterile Contents.

apparatus in contact with water (Fig. 72). When the contents of the pitcher are to be applied to the operation field the same procedure as shown in Fig. 71 is employed.

In the event of a tin boiler or other apparatus being used, the hand corresponding to the one turning the faucet is employed in tilting the receptacle. If a basin be used, care should be taken not to allow the thumbs to encroach on the inside (Fig. 73), but the basin must be held as shown in Fig. 74. The temperature of water and watery solutions employed for surgical purposes should not be left to guessing. For purposes of accuracy an ordinary bath thermometer is of practical use (Fig. 42). The apparatus is sterilized by prolonged immersion in mercuric chlorid solution 1 in 1,000. The thermometer is placed in the pitcher or other apparatus by lifting the sterile towel by the safety pin. The nurse handles the thermometer, carefully avoiding contact with all except the handle, which it is, of course, not necessary to place in the pitcher.

ANTISEPTIC SOLUTIONS

Solutions destined to destroy bacteria by chemical action are of doubtful utility. Chemical agents of sufficient strength to destroy bacteria have a deleterious effect upon tissue. As a general rule, solutions containing antiseptics require one hour in which to destroy bacteria. However, these agents inhibit the growth of bacteria, and when used in conjunction with other means of sterilization have a distinct place in surgical technic. The most valuable function antisepsis and antiseptic solutions fill is in the disinfection of instruments and apparatus which come in contact with the wound. They are of service in cleansing the skin of the patient and the surgeon's and assistant's hands.

CARBOLIC ACID

Carbolic acid, mentioned first by right of seniority, is very frequently employed for the purpose. It is cheap, readily obtained, and in strong solution quite effective. Since it has been determined that alcohol neutralizes its caustic effect when the latter is applied early after the former, it is used extensively undiluted. When pure carbolic acid is applied to a surface it must be displaced by a large amount of alcohol within a few moments after its application. If too long a time be allowed to elapse, the alcohol is no longer effectual. It is also necessary to use a large quantity of alcohol to accomplish the purpose. In solution, carbolic acid is used in the following proportion:

Carbolic acid crystals.........	1 part.
Alcohol	1 part.
Sterile water................	20 parts.

In this proportion carbolic acid is used for washing the skin and for immersion of instruments during an operation in an infected case. Prolonged contact with the hands constringes the tissues, produces anesthesia, and is not infrequently followed by annoying dermatitis. For purposes of cleansing, weaker solutions are used, though not as effective as the stronger.

Sterile water..................	40 parts.
Alcohol	1 part.
Carbolic acid crystals.........	1 part.

Carbolic acid solutions have a certain field of usefulness, especially under conditions where asepsis is not readily obtained. Occasional lavage of the hands or soiled instruments in a solution of carbolic acid during the operative procedure is a useful indulgence. Towels wrung out in a solution of carbolic acid, 1 in 40, are used to cover portions of the body contiguous to the operation field and, while not intended to take the place of towels sterilized by heat, are valuable supplementary agents during prolonged operations undertaken for the relief of infection. It is comprehensible that a towel sterilized by heat is more readily contaminated by contact with infective material than one which is saturated with carbolic acid solution after heat sterilization.

During the operation, instruments are placed on the parts surrounding the operation field and, although these areas are covered with sterile towels, it is not amiss to cover these with towels treated as mentioned, at intervals. This applies equally well to antiseptics other than carbolic acid. In operations undertaken under conditions where a large supply of sterile towels is not available, such as not infrequently obtains in private practice in the country, this should be borne in mind, and perhaps will meet very effectually the indications during an emergency.

For practical purposes a concentrated solution of carbolic acid is kept in a stock bottle and a certain quantity of this added to the water in accordance with the capacity of the vessel employed and the strength of the solution it is desirable to use in a given instance. It is to be borne in mind that carbolic acid is heavier than water and does not dissolve rapidly. The water and acid should be thoroughly mixed before using the solution, to avoid collection of the latter at the bottom of the receptacle, thus preventing contact of the acid with the wound as the last of the mixture comes in contact with it. Especially is this true when carbolic acid solutions are used in an irrigator. If the carbolic acid be poured into the irrigator last, after the water, it gravitates to the rubber tube and is expelled first in concentrated form. Under these conditions the solution is best made in a pitcher first, and after being dissolved poured into the irrigator.

MERCURY

Mercury is perhaps the most universally used antiseptic. It is employed in solution of 1 in 1,000 to 1 in 10,000, according to the purpose for which it is designed. It is cheap, effective, inodorous, and will keep indefinitely. It is poisonous, however, and should not be left in contact with raw surfaces nor allowed to stay in large cavities for fear of mercurialization. It is not uncommon to see salivation and, indeed, even sloughing of the oral mucosa follow its indiscriminate use in wounds of large area. The salts of mercury, chiefly the bichlorid, are used combined with sodium bicarbonate to avoid chemical change in the salt and to enhance solubility.

For use, the salts are kept in concentrated solution to be diluted to the required extent at the time of operating. However, the most convenient form is that of a tablet containing

Mercury bichlorid..........grs. $7\frac{1}{10}$
Sodium bicarbonate.........grs. $7\frac{3}{10}$

The sodium carbonate may be replaced with sodium borate or ammonium chlorid.

One of these tablets to a pint of water makes a solution of 1 in 1,000. The modification of relationship to the solvent to conform to the necessities is purely a matter of mathematics. The manufacturers put the tablet up together with a small amount of aniline dye, which, when the tablet dissolves, renders the solution blue. This avoids mistakes in identifying the solution during the operation, differentiating it from others prepared at the same time.

Again, on occasions, the white bichlorid of mercury tablets have been mistaken by children for confections and swallowed with fatal result. It is advised that the colored tablet be employed. Corrosive sublimate is the form of mercury most generally used.

It is effective, as stated, but has an exceedingly pernicious effect upon instruments. To obviate this the mercuric iodid is used, which is quite devoid of deleterious influences in this regard.

Mercuric iodid	$\frac{3}{8}$	gr.
Sod. bicarb	16	grs.

One tablet dissolved in four ounces of water makes a 1 in 5,000 solution.

Mercuric iodid in 1 in 5,000 solution is as effective in destroying bacteria as bichlorid of mercury in a solution of 1 in 1,000. It does not coagulate albumin and does not corrode instruments.

The mercuric iodid disk, or tablet, is the outcome of work done by *McClintock*.

Cumston advises the following:

Mercury cyanid	gm.	.50.
Sodium borate c. p.	gm.	1.0.

This tablet dissolves very readily and is regarded as more certainly effective than either the bichlorid or iodid of mercury. One tablet to a pint of water makes a solution of 1 in 1,000.

ZINC CHLORID, ETC.

Solutions of chlorid of zinc, 1 in 15; iodin, 1 in 500; sulphocarbolate of zinc, 1 in 80: a saturated solution of boracic acid, sulphurous acid, 1 to 2, or a saturated solution of iodoform in ether have been used for cleansing wounds. They are, however, rarely used for cleansing the operation field, and while possessed of some antiseptic virtues, are not by any means as effectual in preventing infection as the agents mentioned.

Their particular field will be discussed in the treatment of postoperative wound infection.

THIERSH'S FLUID

Thiersh's Fluid is composed of one grain of salicylic acid and six grains of boric acid to the ounce of water. As can be seen from its composition, it is not antiseptic. It is used for cleansing serous and mucous membranes, such as the peritoneum, joint cavities, the conjunctiva, the mucosa of the mouth, etc. It is best, made freshly just before using, the powder being arranged so as to have sufficient of the soluble ingredients to make a pint of the solution in the proportions mentioned, *i.e.,* 16 grs. of salicylic acid and 96 grs. of boric acid are placed in a packet, and when dissolved in a pint of sterile water make the proportion stated.

PEROXID OF HYDROGEN

Peroxid of Hydrogen, while not employed to cleanse the field of operation in clean cases, should be on hand to neutralize infective substances met in operations on infected cases. Peroxid of hydrogen owes its bactericidal qualities to its deoxidizing properties.

It consists of water with an added atom of oxygen. The latter is but unstably associated and is apt to be lost if the container be not very firmly stoppered. When in contact with the wound, an active effervescence takes place, which is believed to cause penetration of the liquid into remote portions of the operative field, and to mechanically dislodge offending substances, at the same time acting as a germicide. Heat destroys its efficacy. It is, therefore, slightly warmed before use, by immersing the container in hot water for a short time. When once the container has been opened, the contents soon become ineffective, and it is recommended that small receptacles be on hand which contain the amount to be used at a sitting and to conserve economy.

When applied to cavities with small openings, provision should be made for ample return of the liquid, as the effervescence is likely to invade surrounding healthy tissue and thus infection be spread. It is used either pure or diluted 25 to 50 per cent. with sterile water. It is only moderately germicidal in the pure state. It is advised that it be used undiluted. As an antiseptic it does not take the place of carbolic acid nor mercuric chlorid. It is useful, however, in replacing these in situations where the antiseptics mentioned are irritating.

PLAIN STERILE WATER

Sterile water, when brought in contact with the tissues, extracts from them certain constituents which are essential to it. Tissue lavaged with plain water decolorizes. This is true both of wounds and untraumatized membranes. The part that the inorganics play in nutrition is unknown, yet it is proven that they are essential to life. Mechanically sterile water is an ideal cleansing fluid. It is cheap, may be obtained in indefinite quantity, and by the process of dilution removes infective substances from the wound or normal tissues. However, it may be regarded as hungry for something to hold in solution, a quality which is objectionable in surgical technic. If this quality applied only to infective material it would be an exceedingly fortunate circumstance, but of course water is not selective in its action and attacks all substances with which it comes in contact, few of which effectually withstand the effect of its prolonged contact.

SALINE SOLUTION

The addition of salt to water overcomes to a considerable extent the objection mentioned in connection with sterile water. No doubt some mechanical law is conserved by the addition of sodium chlorid to sterile water. Saline solution is made by dissolving in a quart of filtered water, sterilized at a temperature of 240° F., a dram and a half of sodium chlorid.

The sodium chlorid should be chemically pure and sterile. The latter is achieved by heat. It is not sufficient to sterilize the salt to render it harmless. All foreign substances must be removed, and, though this is regarded as accomplished by using the chemically pure preparation, close scrutiny of the solution shows fine particles suspended in the mixture. These must be removed by filtration after the solution is made. More especially is this true if the solution is to be used for intravenous injection or hypodermoclysis for the relief of shock (page 259). Having on hand a concentrated solution in sealed tubes (Fig. 40) overcomes all objections. These tubes are filled with solution prepared as here recommended, the tubes are easily sterilized by boiling, and are opened and the contents diluted to the desired extent at the time of the operation, with sterile water.

Solutions of sodium chlorid may be permitted to remain in contact with living tissues for a considerable period of time without deleterious effect. Of course the solution has no bactericidal qualities, and its sphere of usefulness is quite restricted to mechanical cleansing of the operative field. It is largely used for the purpose of lavaging clean wounds, especially those which involve invasion of serous cavities and the mucosa of the stomach and intestines.

When infection is present, it should not be used except for the occasional, intermittent removal of antiseptic solutions. It is probable that, when infection exists, the prolonged contact of saline solution with the wound area promotes infection, on the ground that a condition of affairs is present which favors bacterial flora. The lavage of normal tissues with saline solution stimulates nutritive processes, a conception borne out by the fact that fertilization of the ova of the lower forms of animal life is conserved by the presence of salt solution. The latter proposition has been amply proven by painstaking experimentation.

It is quite probable that in surgery the use of large quantities of saline solution in a clean wound is not objectionable on this score, yet it is also probably true that the tendency has been to use indiscriminately a new method of cleansing wounds without proper regard for the actual problem presented in a given case. On general principles, it may be said that saline solutions should not be employed for the purpose of cleansing infected wounds except in the manner stated above, and in all instances of this sort, it should be finally displaced by a mildly antiseptic solution, such as carbolic acid or corrosive sublimate. In no instances should saline solution be permitted to remain in an infected cavity, proper and useful as the measure may be when infection is not present.

CHAPTER VI

THE PREPARATION OF OPERATOR AND ASSISTANTS

The operating suits—Cleansing of the hands—Canton flannel gloves—Gowns—Gloves during operation—Caps and masks.

It seems hardly necessary to dwell on the question of personal cleanliness as applied to practitioners of surgery. However, in private practice the surgeon not infrequently calls upon unskilled assistants who are likely to assume that when they are covered with a sterile gown during the operation, all other precautionary measures are unnecessary. Indeed, it not infrequently happens that the surgeon slips the operating gown over his waistcoat and regards this measure as sufficient modification of attire to meet the indications.

In this connection it is to be remembered that infection is a question of dosage of fertilization and the gown worn during operating soon becomes soiled with the mixture of solutions and secretions from the operation field. These soon soak the gown, and when the latter is permitted to come in contact with clothing worn underneath, the hands are liable to come in contact with the soaked area and thus become contaminated from infective material beneath the gown.

The surgeon and assistants should take a complete bath at a time as near the hour set for operating as possible. In hospital practice this is perfectly feasible. However, in private practice, when operations are performed in private houses or in the country, this is not always possible. As a matter of discipline, however, the surgeon should arrange the hour of taking a complete bath in such a way as to permit as short a time as is feasible to elapse between the taking of the bath and the operation.

Particular attention should be paid to hair and beard (page 137).

THE OPERATING SUITS

It is the custom in private practice, and it not infrequently happens in hospital work, for the surgeon to remove his coat, waistcoat, and shirt, and slip a rubber apron over the rest of the attire. In hospital practice this is usually the habit on part of the visiting surgeon, the assistants in the form of the house staff being attired in freshly laundered duck suits. The writer advises against this habit on the part of the operator. In private practice the method of procedure stated is carried out both by the surgeon and his assistants, chiefly for lack of other means at command under the circumstances. As a general rule, the method is effective enough. No one would refrain from operating because refinements in this connection were not available. However, the proper and safe attire of the surgeon and assistants is so easily obtained and transported as to make it a matter of but little discomfort to take the necessary precautions.

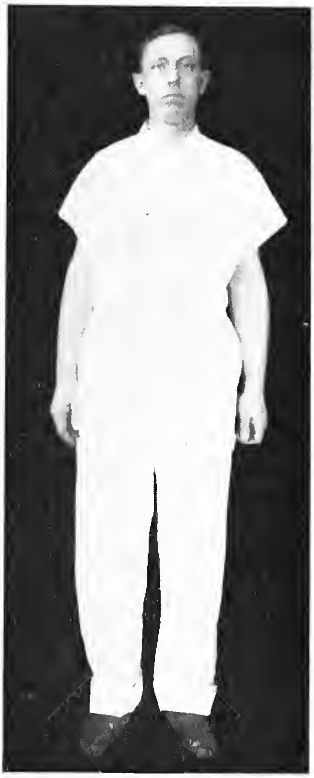


Fig. 75.—Linen or Duck Suit Worn by Surgeon.

It is recommended that the surgeon disrobe completely and replace the street clothes with a canvas or duck suit, consisting of loosely fitting trousers held in place with a drawstring at the waist and a sleeveless blouse tied with tapes in front. The feet should be incased in canvas rubber-soled shoes (Fig. 75).

This outfit is easy to cleanse, does not take up much room, and can be placed in the bag carrying other necessities. It is worn next the skin, and when the operation is completed, the surgeon replaces it with his original attire, which is not soiled, is dry and clean, and promotes a feeling of comfort and cleanliness which is not disagreeable. Not infrequently the surgeon leaves the operating room with wet underwear and bespattered shoes and goes out into the streets in a condition favorable to contracting bronchitis or worse, to say nothing of the disagreeable impression made by the bespattered shoes and odorous disinfectant and ether-impregnated clothing.

It will be seen that the attire shown in the illustration is held in place by tapes. The operating suit has to be relaundered after each operation, and if provided with buttons these are very likely to be broken or torn off in the process of washing and ironing. For this reason it is best to use tapes for the purpose. The rubber-soled shoes are desirable, as it not infrequently happens that irrigating and cleansing solutions flow to the floor during operations, and the surgeon is compelled to stand in a messy pool. The shoes are worn without socks, and are carefully cleansed after each operation.

The attire of the surgeon and assistants should be completed outside the operating room. In hospital practice a special chamber is set aside for this purpose. The surgeon disrobes, and the operating suit is placed in a convenient place ready for wear.

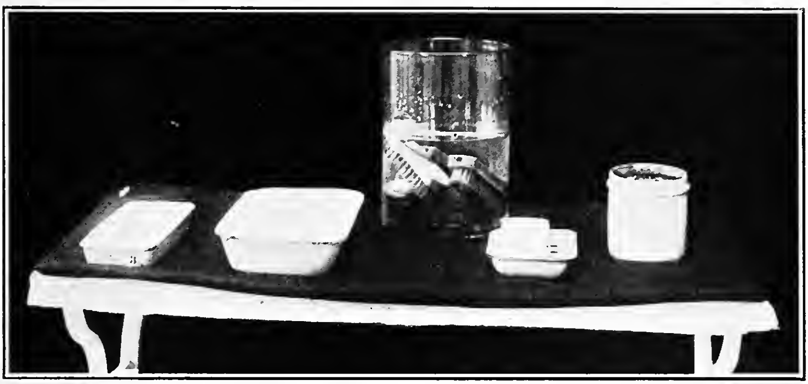
In private practice a chamber contiguous to the operating room is used for the purpose, and the operating suit, wrapped in a muslin container, is removed from the bag by the nurse and the surgeon puts it on. The last visit of the operator to the patient just before narcosis begins should, however, be made in street costume in order not to arouse apprehension which the operating suit would be liable to cause, were the surgeon or his assistants to present themselves in a garb so indicative of their work.

The surgeon and assistants, after attiring themselves in the manner stated, are now ready to make the final preparation for the surgical manipulation.

CLEANSING THE HANDS

In some hospitals, and at times in private practice, the mechanical cleansing, *i.e.,* the scrubbing of the hands and forearm, is performed in a chamber contiguous to the operating room. The writer regards the performance of this act best done in the operating room. In private practice this is quite impossible, as few, if any, extemporized operating rooms have running water connections. In hospitals this is, of course, provided for. Again, in some hospitals the entrance to the operating room is provided with a swing door which permits of access without contact of the hands. However, the less possibility there is of contact with extrinsic substances after the cleansing of the hands is begun the better. The basin used should be roomy and should permit of submersion of the entire hands and forearms.

For convenience, a table is placed beside the wash basin holding a glass jar with sterile brushes, orange sticks, and a nail file submerged in a solution of carbolic acid 1 in 100, a jar of green soap, and two enameled dishes, one containing chlorid of lime and the other sodium carbonate (Fig. 76). A large quantity of



1 2 3 4 5

FIG. 76.—TABLE WITH MATERIAL FOR CLEANSING HANDS. 1, Tray with calcium chlorid; 2, Tray with sodium carbonate; 3, Jar containing nail brushes and orange sticks; 4, Ordinary toilet soap; 5, Jar of green soap.

water and a liberal amount of soap should be employed. The normal epidermis is most thoroughly impregnated with bacteria, and the object of the scrubbing is not to destroy the bacteria, but to remove them, and this can only be done by removing a portion of the epidermis. Consequently it is advised that the hands be permitted to remain in warm water for a few minutes before the soap is applied and thus the epidermis be macerated and in a condition favorable to removal. This manipulation should take place in a roomy wash basin, the supply cocks of which are manipulated by the foot (Fig. 77). The illustration shows a desirable arrangement in this regard. The two upper cocks are connected with the sterile water tanks (Fig. 77), and are supplied with a hand valve which readily identifies them from the lower outlet connected with the general water supply. After the hands and forearm have been soaked for several minutes they are rinsed

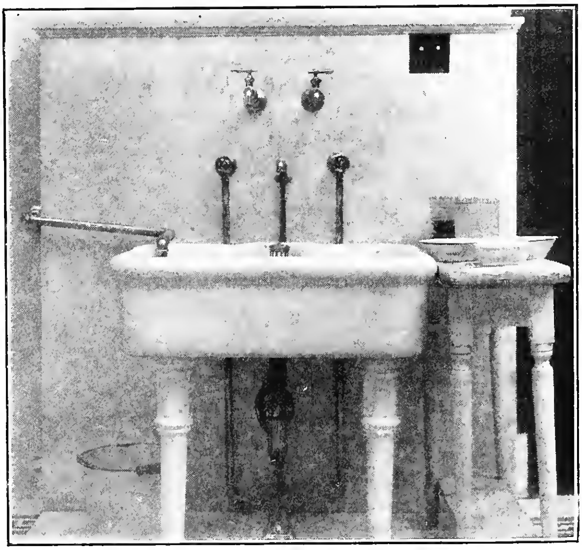


Fig. 77.—Wash Stand Used for Cleansing Hands. The two upper outlets are connected with the sterile water tanks placed in a contiguous room. The table with the material necessary for cleansing the hands is placed beside the basin.

in the water and the supply in the basin drained off and replaced with fresh water. The hands and forearms are now coated with green soap from the jar (Fig. 76), and the soap thoroughly rubbed into the skin. For this purpose green soap which has been sterilized by heat is the most useful agent. It contains considerable free caustic potash which, together with the serum and exfoliated epidermis, makes a mixture in a condition favorable to removal. Haste should be avoided at this time to permit of a thorough incorporation of the soap with the skin. During the time that the soap is in contact with the skin the finger nails are cleansed with a sharpened orange stick or nail file. The former is preferable as being less liable to injure the skin contiguous to the nail.

The tincture of green soap and the ordinary toilet soaps (Fig.

76) are used in this connection, and are perhaps as effective as the green soap, however, for the reasons stated the green soap is recommended.

This mixture is now lavaged with clean water, using the fingers as in an ordinary toilet. The water in the wash basin is again replaced, and with fresh green soap the hands and forearms are freely lathered with the aid of the brush taken from the glass jar. The brush should be used gently and should not be sufficiently harsh to scratch the skin which is now particularly liable to this accident as the outcome of the previous manipulations. This lather is then washed away with clean water.

This constitutes the mechanical cleansing of the hands and forearms, which should require seven to ten minutes. It is the most important step in the preparation. It is difficult to see how chemical action alone can achieve sterility of the hands, and indeed it has been proven that it does not. Indeed, if any neglect occur it would conserve most the interests of the patient to disregard certain manipulations destined to destroy bacteria by chemical action (antisepsis) than to err in the mechanical cleansing. After the hands and forearm have been treated as described, they are coated with chlorid of lime made into a paste with water, and this is supplemented by applying, while the lime is still on the skin, the sodium carbonate. This mixture liberates chlorin, and is intended to destroy bacteria. *Wier* of New York first introduced this method, and it is generally employed.

Care should be taken not to scratch the skin with rough portions of either the lime or soda. The application gives rise to a sensation of warmth which soon disappears, however. After the feeling of warmth leaves, the mixture is removed with a solution of bichlorid of mercury 1 to 1,000, using a piece of sterile gauze for the purpose. Care should be taken to remove entirely the lime and soda, for if they be permitted to remain in contact with the skin for a protracted period of time dermatitis is liable to ensue. Indeed, frequent employment of the measure is extremely liable to produce dermatitis, a fact which makes the measure objectionable if employed at frequent intervals. It is the habit of the writer to employ the measure for the first operation, and to omit this particular step from the technic of cleansing of the hands and forearms previous to subsequent operation performed at the same sitting. Experience would justify the omission.

After removing the lime and soda in the corrosive sublimate solution, the hands and forearms are immersed in alcohol, this rinsed off in a solution of carbolic acid 1 in 100, and finally the latter removed with sterile water.

To facilitate removal of the lime and soda mixture, the hands and forearms may be rinsed in a solution of sodium carbonate (2 per cent.) before immersion in the corrosive sublimate solution, a measure which aids somewhat in obviating the occurrence of dermatitis. For convenience the latter three manipulations

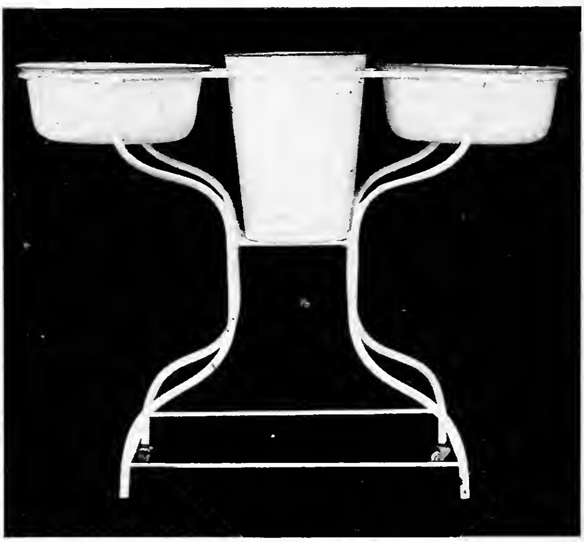


Fig. 78.—Immersion Bowls Containing Antiseptic Solutions for Cleansing Hands and Forearms.

are performed in an apparatus shown in Fig. 78. The containers for the purpose should be roomy and permit of complete immersion of the parts. The center one shown is the most desirable form.

This method of cleansing the hands is as effective as any known to the writer. It is not claimed that the hands and forearms are sterile after its employment. However, it may be said that absolute sterility of the hands cannot be achieved as the outcome of even the most thorough and painstaking cleansing, a fact borne out by bacteriological examination of the skin and finger nails of persons who have subjected them to the method of cleansing generally regarded as effective for the purpose, as shown by clinical facts. It is a singular fact that the nearest approach to sterility of the hands is obtained after the operator has performed one or two operations, the bacterial flora being less marked in proportion to the length of time the hands have been in contact with aseptic or antiseptic material. This should argue that the perspiration mechanically cleanses the skin and that ultimately the growth of bacteria in the skin is exhausted as the outcome of copious dilution of its culture medium by material not fertilized. At best an inhibition of the growth of bacteria, the outcome of the combination of mechanical cleansing and antiseptic lavage only is achieved. Yet it may, too, be said that in the vast majority of instances this attainment suffices for practical purposes. On the other hand, infection is in the opinion of the writer most uncommonly the result of contamination with instruments, and, indeed, the appurtenances used in surgical manipulations, and that the surgeon's hands and the conditions which obtain in the wound are the two elements entering into the proposition which are most difficult to keep free from infective causative factors.

Modification of the above method of preparation is employed, and indeed certain variations are perfectly permissible. However, as far as the mechanical cleansing is concerned, no method yet presented is more useful and none as good. The lime and soda mixture may be replaced by coating the hands with a saturated solution of potassium permanganate, which is later displaced with oxalic acid, or similar antiseptic preparations may be used in place of either of these, but the rest of the manipulations are not susceptible of modification, and should be carried out as stated.

The cleansing of the hands takes place while the surgeon is still attired in the canvas suit mentioned and before incasing himself in the sterile apparel in which the operative work is done. During the manipulations of getting into these the hands are quite likely to become fertilized, and it is suggested that sterile canton flannel gloves be worn at this time.

CANTON FLANNEL GLOVES

Canton flannel gloves (Fig. 79) are too cumbersome to be used during operations, but are of service in the capacity men-

Fig. 79.—Canton Flannel Gloves. (*Bryant.*)

tioned, and indeed may be kept on until just before the operation is begun, for it not infrequently happens that the operator desires to indulge in some manipulation which might contaminate the hands, and if these be protected with the canton flannel gloves, which are subsequently removed, no harm will arise as the result.

GOWNS

The operator and assistants should wear sterile gowns. The gown should be commodious and fasten behind. A description of the gowns has already been given (page 68). In this connection it is well to state that the gown worn by the operator and first assistant should have long sleeves, preferably unattached to the gown, that they might be replaced during the operation when soiled by blood or secretions, and those of the other assistants, not coming in contact with the wound, may be short. When the gown is once put on the surgeon must avoid contact with foreign substances. It not infrequently happens that the surgeon is all ready to proceed, but the patient is not quite narcotized. During this time there is a tendency on part of the operator to become impatient, and it has been the writer's experience to see the surgeon seat himself on a chair with all the attire for operation on and engage in conversation with the assistants or spectators, the subject of which is not infrequently a dissertation on the stupidity of the assistant administering the narcosis. It is suggested that the surgeon, who of necessity is in a more or less tense state of mind, do not put on the final sterile attire until the patient is on the table, in the meantime protecting the hands and forearms with the canton flannel gloves. This permits of greater ease and freedom during a perhaps trying period of time, allows of the giving of whatever instruction is desired to spectators, and in the last moment the donning of the final attire, which requires only a few moments and assures the absence of contamination. The kind of gown worn during operations by the writer is shown in Fig. 85.

GLOVES DURING OPERATIONS

This subject cannot be dismissed with the bald statement that the interests of the patient are best conserved by the wearing of rubber gloves by the operator and assistants. In discussing the subject *Kocher's* views have been considered as having had a somewhat determining influence on those of the writer.

If the hands could be covered with an impermeable glove which under no circumstances permitted of contact between the skin of the operator and the wound, the entire problem would be solved except as regards the question of the tactile sense. The latter is at all times an important factor in surgical manipulations. The writer feels that as the outcome of training, the tactile sense may be developed, so as to be of sufficient practical acuteness despite the presence of the glove, in the majority of instances. Yet there are undoubtedly instances when the interests of the patient are best conserved if the necessary manipulations are carried on without this handicap.

If it be true that infection is a question of dosage, it appears to be justifiable that all assistants wear gloves in all instances and the operator in most cases, abstaining from their use, however, when the manipulations become inaccurate and prolonged. If in these instances the hands be cleansed as stated and frequently submerged in a cleansing solution during the operation, it is the writer's belief that the indications are met on the most rational basis.

It is to be borne in mind that infective bacteria inhabit the

Fig. 80.—Hand and Wrist Covered with Rubber Glove and Gauntlet. Forearm Bare.

ducts of the sudoriparous and sebaceous glands of the skin. After cleansing the skin these are not removed. If the hand be incased in rubber gloves these glands are stimulated into hypersecretion and a thin coating of bacteria-incorporated sweat lies in a layer between the skin and the glove. If a solution of continuity occur in the glove as the outcome of contact with an instrument, such as a needle, scalpel, scissors, or the wound itself, this mixture is quite forcibly projected into the wound. This is objectionable. To obviate this it is perhaps best to wear cotton gloves for the first portion of the operation. These will absorb the perspiration and can be frequently changed so as to avoid saturation, that is, a clean pair is substituted before the infective perspiration has permeated

FIG. 81.—HAND COVERED WITH RUBBER GLOVE, FOREARM BANDAGED WITH STERILE GAUZE, GAUNTLET TURNED OVER BANDAGE.

to their outer surface. After a certain period of time the perspiration dilutes the bacteria to a sufficient extent to render the

FIG. 82.—FOREARM COVERED BY LONG SLEEVE OF GOWN, GAUNTLET OF RUBBER GLOVE TURNED OVER SLEEVE.

skin quite free from bacteria. It would seem to be most rational to wear cotton gloves during the technic of the first portion of the operation, that is, during the approach to the area where more delicate manipulations are necessary, and substitute rubber gloves at this time, or, if necessary, the operator may rinse the hands at this time in a solution of bichlorid of mercury 1 in 1,000, which is displaced with sterile water and proceed with the operation with bare hands.

Cotton gloves are less liable to be injured during the manipulations involved in tying ligatures and inserting sutures. The rub-

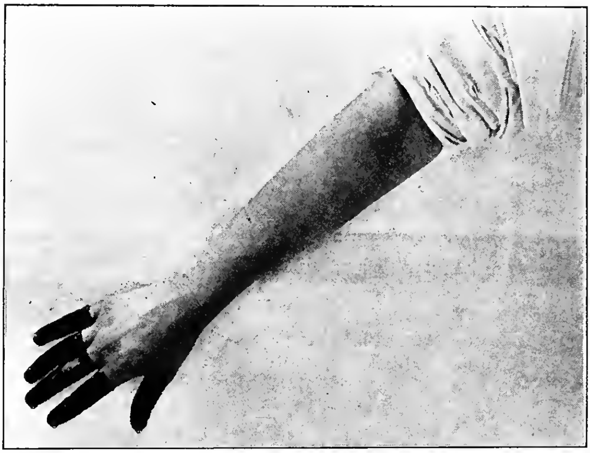


Fig. 83.—Ends of Fingers Covered with Rubber Finger Cots.

ber gloves should be provided with a gauntlet which covers the wrists (Fig. 80). Some surgeons prefer to incase the forearm in a sterile gauze bandage (Fig. 81). The most useful method is to cover the entire arm with the long sleeve (Fig. 82). Not a few surgeons regard the ends of the fingers as most likely to be fertilized, and protect these with finger cots (Fig. 83). However, this is not recommended for prolonged operations, though exceedingly convenient when the means for thorough cleansing of the hands be not attainable and the operation consist of a simple opening of an abscess or a cellulitis.

CAPS AND MASKS

During operations caps and masks are worn by the operator and first assistant. Surgeons use various protectors for the hair and face. The object being to prevent the falling of perspiration and loose hair into the wound. The cap does not achieve the object as well as the mask and hood combined. Many models are in vogue, the one which is as useful as any is the *Crile* mask, shown in Fig. 84. It is effective, light and readily put on.

FIG. 84.—*Crile* MASK.

FIG. 85.—SURGEON ATTIRED FOR OPERATING.

Fig. 85 shows the complete attire of the surgeon ready for operation. The gown is put on first, next the gloves, the gauntlets of which are turned over the wrist, and the mask is put on by the non-sterile nurse, as it would be quite impossible for the surgeon to do this himself without contamination of the hands.

The attire of the first assistant is in all respects similar to that of the operator. The assistant handling instruments and suture material may wear a gown with short sleeves, a cap in place of a mask, but should wear gloves. It is warned that if the latter test the tensile strength of ligature and suture material with the hands, care be taken not to incise the gloves with the material.

The assistant administering the narcosis need not indulge in the elaborate preparation nor the attire mentioned, but should be attired in freshly laundered duck or be covered with a gown. In the event of the operation involving the head this assistant makes the same preparation as the operator.

The nurse handling sponges, towels, dressings, etc., should be prepared in the same way as the operator, but instead of wearing a cap ties the hair up in sterile gauze. Fig. 86 shows the attire of the so-called "sterile" nurse.

Fig. 86.—Attire of "Sterile" Nurse.

The extra sterile manipulations are performed by a second nurse, who should wear the hair tied in gauze, be attired in freshly laundered uniform, but need not wear a gown similar to that worn by the sterile nurse. The object of this is that during the operation the operator is less apt to confuse the nurses, and not call upon the non-sterile nurse to perform a duty which belongs to the sterile nurse, and vice versa. This is a wise precaution to take.

The non-sterile nurse replenishes solutions and pours cleansing fluids on the operation field. The method of handling pitchers is already described (page 115). The handling of basins is an important matter. Nurses are apt to contaminate the interior of these vessels while handling them. Fig. 73 shows a commonly employed, erroneous way. It will be seen that the thumbs encroach upon the inside of the bowl. Fig. 74 shows the proper way of handling a basin.

CHAPTER VII

THE OPERATING ROOM

The hospital operating room: Artificial illumination—Operating table—Dressing table—Instrument table—Narcotist's table—Adjustable tray for instruments—Surgeon's lavatory—Utensil sterilizer—Irrigation—Arrangement of tables, etc., in operating room—Dressing of tables in operating room: the operating table; the instrument table; the anesthetist's table; adjustable instrument tray; dressing table—Final preparation of patient—Disposition of operator, assistants and nurses.

The operating room in private practice: Operating table: portable operating table; extemporized operating table—Sterile water—Suture and ligature material.

THE HOSPITAL OPERATING ROOM

In hospitals and sanitaria, special chambers are arranged for the purpose of performing surgical operations. In private practice it is not possible to obtain the favorable conditions found in these institutions. It is intended to describe first the operating-room arrangement, which is most desirable, and which exists to a greater or lesser degree in these institutions, and later take up the subject as applied to private practice where modifications of this arrangement are necessary, and thus, while setting up a standard, show how this may be modified under certain circumstances, with favorable and satisfactory outcome. In describing what the writer regards as the most acceptable and useful arrangement, in this regard, it is intended that a standard should be made for comparison for the benefit of the operator who works in private residences, that the best might be as closely as possible approached, though this involve considerable modification as regards the apparatus employed.

The operating room should be at the top of the building, be large and readily ventilated and lighted on three sides with windows, and be furnished with a skylight. The skylight should be so situated as to allow of light falling on the operating table at an angle which will at the same time permit of lateral illumination. That is, it should be possible to have the light from the side windows fall on the perineum when the patient is in the lithotomy position and at the same time permit the patient being placed in the *Trendelenburg* posture without changing the location of the operating table for the purpose of obtaining the necessary light nor of turning it around after the perineal work is finished, or the reverse. For instance, in combined vaginal section and celiotomy, the former requires light from the side windows. When the celiotomy is to be made, if light from one end of the room only is obtainable, it becomes necessary to turn the table about so as to have the light fall into the wound during the intra-abdominal manipulations. If the light from the skylight comes in the opposite direction from the side windows necessity for this is obviated. This applies with equal force to the reverse. If after a celiotomy is completed it becomes expedient to make vaginal drainage, this may be accomplished without moving the table for the purpose of obtaining the necessary illumination. The skylight should be permanently sealed, as the ropes or reach rods which are necessary to open and close windows in a skylight will, when manipulated during an operation, shake down dust, and this is to be avoided. If the side windows are carried sufficiently high up, efficient ventilation through these openings is at all times available. If possible, the operating room should derive its principal source of light from the north.

The floor of the operating room should be tiled, the tiles set in four inches of cement, and should have a smooth surface, to permit of cleansing and to avoid absorption of foreign substances, including blood, pus and secretions, which inevitably find their way to the operating-room floor during surgical manipulations. The center of the floor should be provided with a drain and the surface of the floor arranged to permit of the flow of cleansing fluids to this point. Various mixtures of cement and plaster have been used to make solid flooring, none of which are, however, as permanently lasting as the tiling.

The junction of the floor and walls should be provided with a curved tile which permits of ready cleansing and avoids, too, collection of dust and foreign particles in this situation. The walls should be tiled to the height of six feet and the upper portions made of cement painted with four or five coats of enameled paint. The junction of wall and ceiling should be arched rather than make an acute angle to avoid collections of foreign substances in this situation. The entire interior of the room should be white, to facilitate the detection of objectionable material and enhance illumination.

ARTIFICIAL ILLUMINATION

Artificial illumination should be by electricity, and the current governed from a side-wall switch to avoid shaking down of dust, the outcome of manipulations at the chandelier. The chandelier should be furnished with a reflector and the electric light bulbs grouped in a cluster to avoid the throwing of confusing shadows on the operation field. The source of light should be sufficiently high over the table to avoid contact with the operator during manipulations such as suturing with a long suture during celiotomy in the *Trendelenburg* posture.

The section of wiring conveying the electric current to the operating room should be heavily fused and the wires themselves made of ample capacity to carry a current of sufficient strength, to be available for the animation of motors for the purpose of running burrs and drills, and also for the purpose of heating a cautery knife. It is an annoyance, to say the least, to have the steps of an operation interrupted as the result of a fuse "burning out" while the operator is manipulating in the opened abdomen, and thus be compelled to delay the procedure until the necessary repair is made, simple as this is.

When electric light is not available, the chandelier in the operating room should be so located as to make it possible to carry on the operation at some place other than immediately beneath it, and when it becomes necessary to use the artificial light the table may be moved to immediately beneath it.

Of course, in instances when operations are performed at night, the gas jets are ignited before the operation is begun and no manipulations in this connection are necessary during the operation. However, it not infrequently happens that the operation is begun with ample available daylight and the contingencies of the surgical problem make continuance of the effort a prolonged one, so that darkness occurs before the operation is finished. Indeed, a thunderstorm will frequently obliterate the daylight at midday, and it becomes necessary to employ artificial light in the midst of an operation. Under these circumstances, it is of course not feasible to ignite the gas without manipulating the chandelier, and dust is shaken down on the operating field unless the precaution mentioned is taken.

If, however, the gas chandelier be located immediately over the operating table, the wound and contiguous area should be covered with a sterile sheet while the gas is lighted by the non-sterile nurse, and later the same person removes the sheet, together with the dust, after which the operation is proceeded with.

The apparatus necessary to the sterilization of water and dressings (Fig. 66) should be set up in a chamber contiguous to the operating room. The water sterilizers, however, should be piped into the operating room, that the supply in use may be replenished without the attendant being forced to leave the room. The dressings, sponges, etc., are packed in convenient parcels which can be transported to the scene of operation without danger of contamination.

The instrument (Fig. 16) and utensil sterilizers (Fig. 96) should, however, be in the operating room, as conditions constantly arise making immediate resterilization of this appliance necessary. An instrument is dropped to the floor or is fertilized by contact with infectious material quite frequently during an operation, and means for rapid sterilization should be at hand. The same may be said of pans and basins and pitchers, and when these are at once placed in the sterilizers they become available for use after a short period of time, a desirable provision which tends to obviate delay and annoyance during the operation.

OPERATING TABLE

The table shown here (Figs. 87-90) is as serviceable as any in the market, and provides for the requisites of most contingencies arising during operative work. There are many tables on the market which will serve the purpose, indeed in some instances the surgeon does more satisfactory work as the outcome of familiarity with a table which may be less complete in every particular than obtains in the table shown here, but it may also be said that this particular table may be regarded as a standard which if it have any fault is too elaborate, and that on general principles the centralization of too many possibilities is liable to mean mechanical complications.

It is, for instance, perfectly feasible to attain the *Moynihan* position for easier access to the bile passages by placing a sand

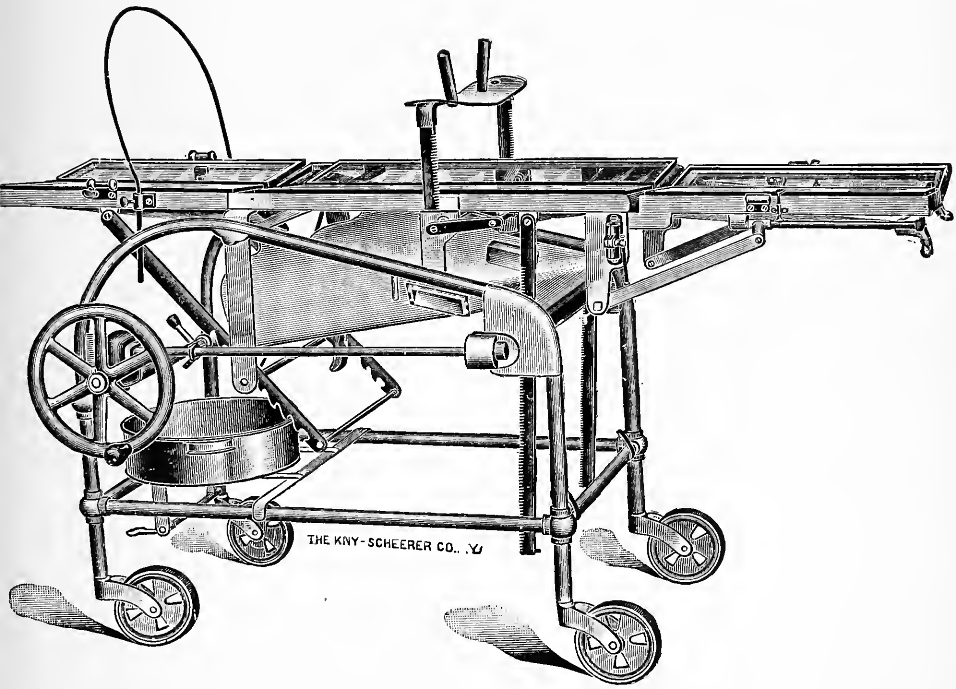


Fig. 87.—Operating Table Showing Appliance for Raising the Upper Abdomen or for Use in the "Kidney" Position.

bag under the patient, yet the *Cunningham* adjustable elevating attachment is certainly more readily adjusted to varying conditions than the former. The table here shown is the result of the ingenuity of *Dr. Francis Markoe* of New York City. The table frame is of tubular iron; the drainage pan attached to the base is wider than the top of the table, assuring drainage on the sides when lavage is made, preventing the solution from running on the floor or soaking into the lower garments of the surgeon and his assistants. The base is designed to permit of the tops being lowered, the plane at the foot end facilitating the *Hartley* position. The foot end is adjustable to any angle; it is also arranged to drop back, permitting the use of weighted specula in the lithotomy position. Close scrutiny of the cut (Fig. 88) will show that the foot-piece not only drops down at an angle of 90°, but also slips backward, allowing an overhanging of the end of the center sec-

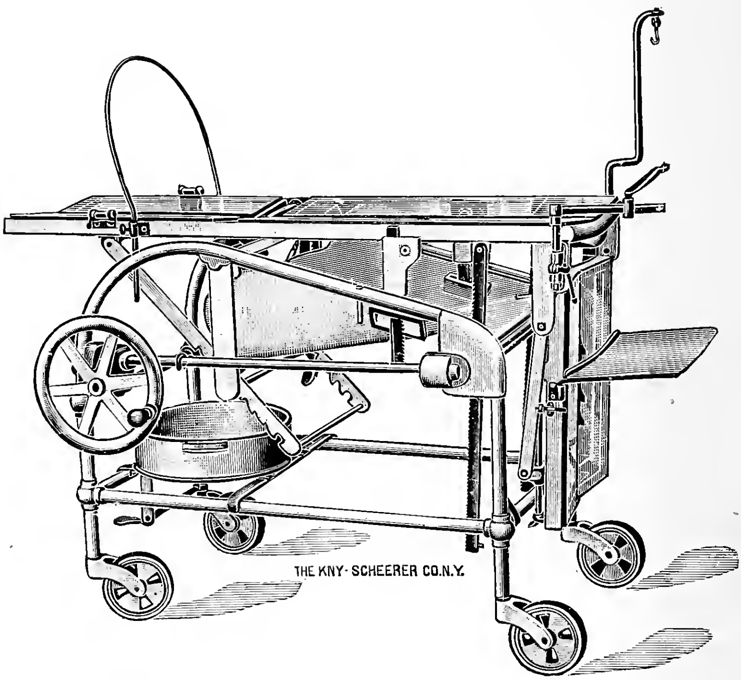


Fig. 88.—Operating Table Showing Appliances for Lithotomy Positions and Wire for Screening off Narcotist.

tion to permit of the manipulation stated. This prevents the assistant's hand, while holding a speculum, from getting in the way.

The *Trendelenburg* posture is achieved by means of the *Delatour* side-wheel attachment with rack and pinion, which is controlled by the narcotist, thus obviating disturbance of the celiotomy sheet during changes of posture. A foot pedal at the end of the table near the head section allows of raising of this section by the narcotist as occasion arises.

The *Cunningham* elevating attachment is adjustable, and is either used with the side braces to maintain the kidney position or without these braces for the *Moynihan* position for work on the biliary passages. The *Lange* table is attached when necessary to the foot section and serves as a foot rest in the *Hartley* position. The wire screen shown in Figs. 87-90 holds the celiotomy sheet away from the narcotist and isolates the head of the patient from the rest of the table, a desirable arrangement in instances in which local or spinal anesthesia is employed. The patient is thus unable to see the manipulations, a factor which has a bearing on the mental shock, so often the sequel of operations undertaken with local anesthesia. Beyond this the table is furnished with shoulder supporters to prevent the patient from sliding upward when in the *Trendelenburg* position and lithotomy stirrups. Fig. 87 shows the table with screen frame and *Cunningham* elevating attachment. Fig. 88 shows the foot rest, the foot section dropped and a heel cup and lithotomy stirrup attached. Fig. 89 shows the table in

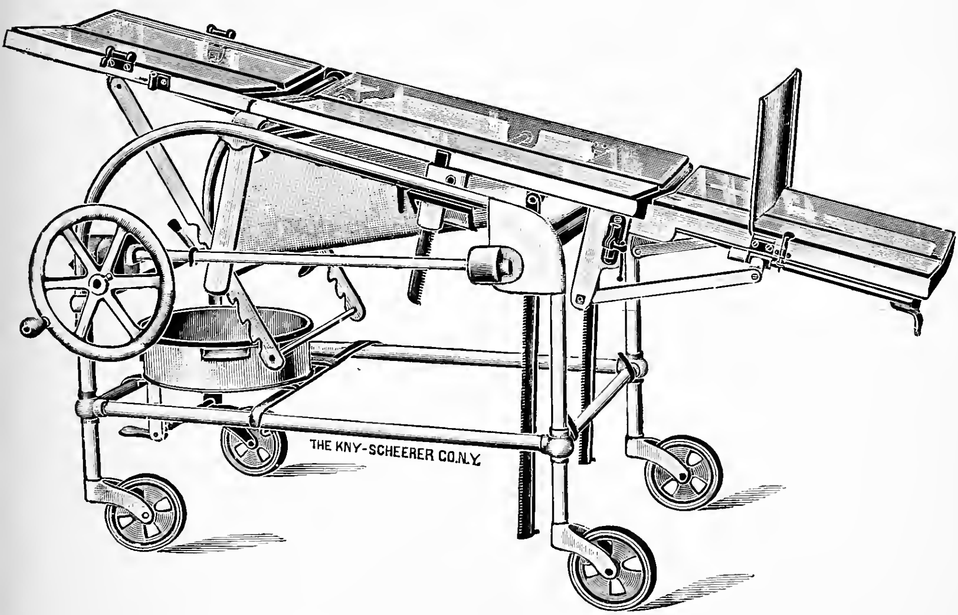


Fig. 89.—Operating Table Arranged for *Hartley's* Position.

the *Hartley* position with the foot rest attached to prevent slipping of the patient. In neither of these illustrations are the shoulder supports shown, which are of course only attached when the *Trendelenburg* posture is to be employed. Fig. 90 shows the table in the *Trendelenburg* position with shoulder supports attached, though the head section should perhaps be best slightly raised to show the most generally employed *Trendelenburg* position. If the foot section is dropped when the patient is to be placed in the *Tren-*

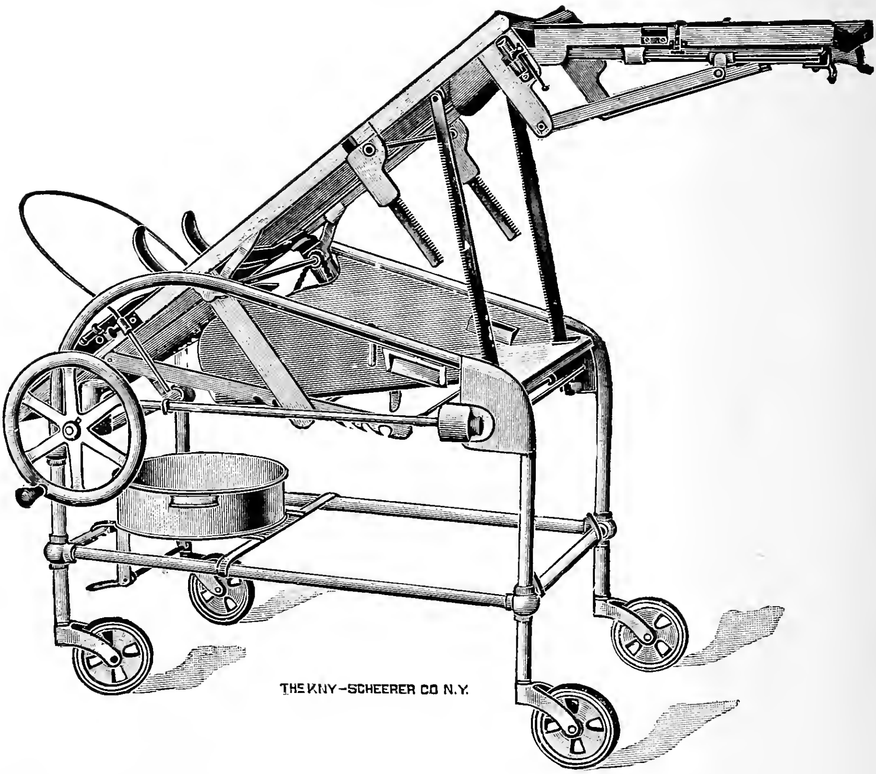


FIG. 90.—OPERATING TABLE IN *Trendelenburg's* POSITION.

delenburg posture, the weight of the legs prevents undue pressure on the shoulders from contact with the supporters, though it also makes tense the abdominal muscles.

DRESSING TABLE

A table for dressings, wipes, towels, etc., should be available. Fig. 91 shows a steel white enameled table frame with two glass shelves. The dimensions of this table are about 24 by 36 inches, of ample size to hold sufficient material for an ordinary operation, and is not so large as to be unwieldy. If an extensive operation or two or more operations are to be performed successively, two of these tables may be arranged contiguous to each other.

Fig. 91.—Table for Dressings.

Fig. 92.—Table for Instruments.

INSTRUMENT TABLE

Fig. 92 shows a roomy steel frame table with two glass shelves suitable for instruments during the operation. This table should be the same size as shown as a dressing table (Fig. 91). Of course either table may be used for either of the purposes mentioned.

A table as shown in Fig. 91 may be used for suture material containers, jars of catgut (Fig. 49), needles, etc. The instrument and suture material tables should stand beside each other as both these classes of surgical desiderata are usually handled simultaneously.

NARCOTIST'S TABLE

The table shown in Fig. 93 is used by the narcotist, to hold the receptacles containing the narcotic, stimulants, a hypodermic syringe, etc. The table is of steel, white enameled, as are the other tables, and has a glass shelf. The lower shelf is of enameled steel and holds the pus basin used to receive the vomit during or immediately after the operation. The rack below the lower shelf is intended for towels which may be used to wipe the patient's face or lips during the operation.

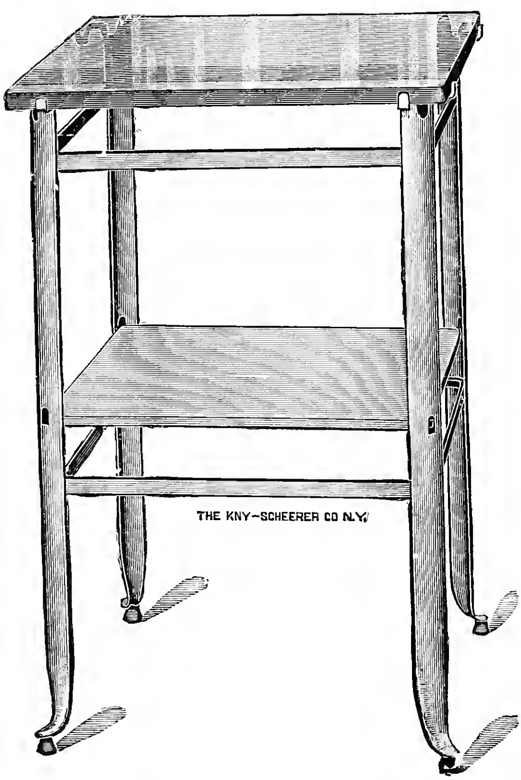


Fig. 93.—Narcotist's Table.

ADJUSTABLE TRAY FOR INSTRUMENTS

During an operation a certain number of instruments are more or less constantly in use. To facilitate the work an adjustable table frame with an enamel tray (Fig. 94) is placed close to the surgeon, and the assistant handling the instruments places the instruments for immedate use upon it. The table is usually placed to extend over the operating table. By means of the set screw the tray is raised or lowered by the telescoping of the upright to meet the necessities.

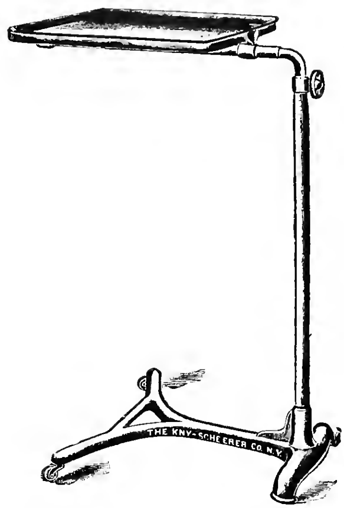


Fig. 94.—Adjustable Instrument Tray.

When an instrument is temporarily laid aside it may be placed upon this tray, rather than upon the area contiguous to the wound. The latter is usually soiled with blood and secretions, which makes it an objectionable place to lay instruments upon. Again, if during the operation the patient should struggle the instruments are less liable to be thrown to the floor, if placed upon the tray, than if the body of the patient be used for the purpose.

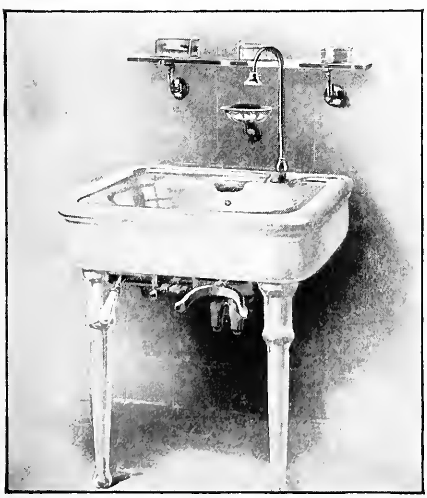


Fig. 95.—Surgeon's Lavatory.

SURGEON'S LAVATORY

The surgeon's lavatory should be, as already stated (page 127), sufficiently roomy to permit of the submersion of the hand and forearm. The basin shown in Fig. 95 is fitted with a knee lever attachment allowing of the delivery of either cold or hot water. The knee lever at the left side in the center opens or shuts the waste. The material necessary to cleansing the hands is placed on the glass shelf immediately above the wash basin and is thus readily available. The toilet soap is placed in the small soap tray affixed to the wall

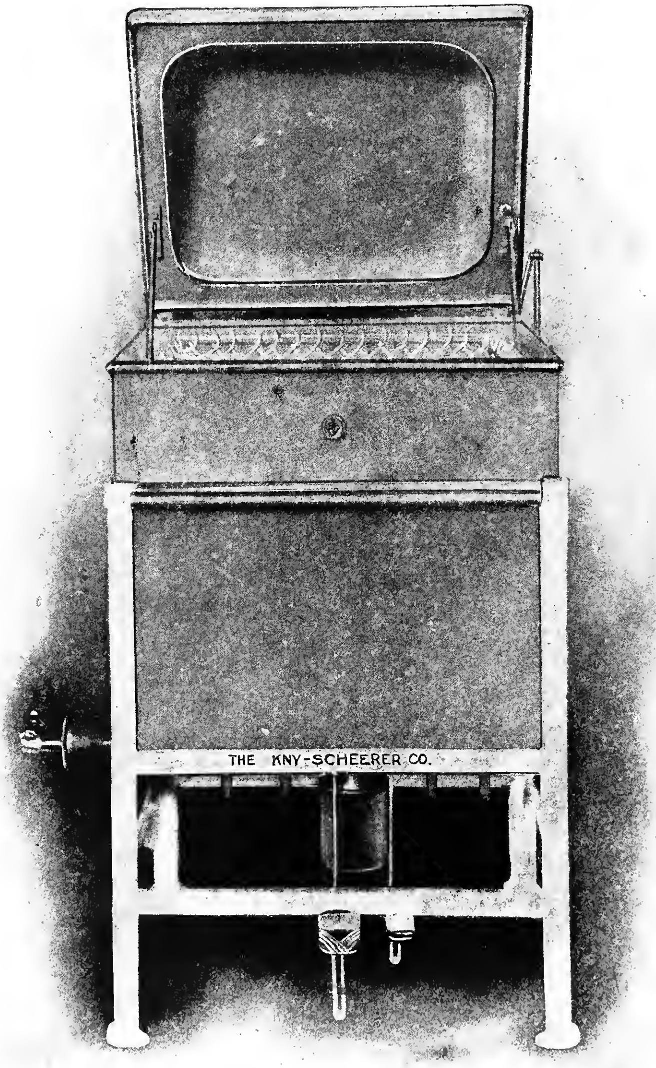


Fig. 96.—Operating Room Utensil Sterilizer.

beneath the shelf. The water outlet is arranged in a "gooseneck" which permits of lavage of the hands and forearm with running water.

This apparatus is very convenient and quite useful for the purpose. It is well to bear in mind, however, that it represents a refinement which, while acceptable, is in no wise essential to cleansing of the hands. The ordinary, roomy wash basin will suffice very well for the purpose, and indeed has the redeeming feature of being less complicated in its mechanism.

UTENSIL STERILIZER

The utensil sterilizer (Fig. 96) should be, as already stated, located in the operating room. It is fitted with a foot pedal, by means of which the cover may be raised and the tray elevated without the need of using the hands.

The appliance is used for the purpose of sterilizing pitchers, basins, irrigating vessels and the like. It is fitted with either the direct Bunsen burner flame or is connected with the steam pressure of the power plant in the building. The former method of heating is preferable. The contents should be exposed to a temperature of 212° F. for half an hour, which will completely sterilize it.

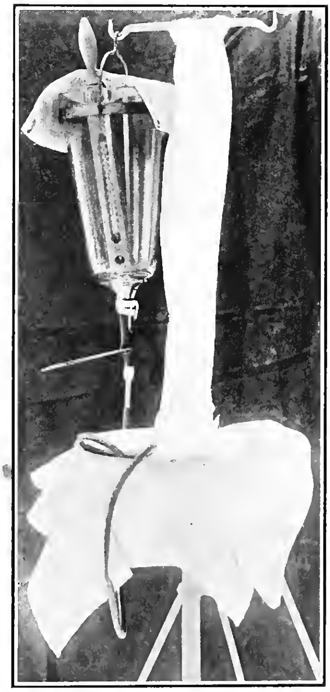


Fig. 97.—Operating Room Irrigating Apparatus.

IRRIGATION

For the purpose of lavage during the operative procedure, besides the pitchers already mentioned (page 115), it is well to have at the disposition of the surgeon an irrigator, especially as the latter may be used for infusions, enteroclysis, and hypodermoclysis. A useful apparatus for the purpose is shown in Fig. 97. A glass receptacle of a gallon capacity is swung from the hook at the top of an upright. The receptacle is connected at the bottom with a rubber tube. A thermometer (Fig. 42) is placed in the retort, and to prevent the contamination with the infective material a sterile towel is made to cover the open top. The rubber tube is led into a basin affixed to the stand containing a solution of mercury bichlorid, 1 in 1,000. The tube is shut off by means of a forceps, which is released when it is desired to have the solution flow, the various "cut-off" appliances in the market rarely being efficient for a sufficient period of time to render their employment desirable.

ARRANGEMENT OF TABLES, ETC., IN OPERATING ROOM

Fig. 98 is a diagrammatic presentation of a convenient method of arranging the tables in the operating room, and also the arrangement of the assistants to serve best the contingencies. Fig. 99 shows the tables, irrigator, wash basin, and instrument case as arranged in a well-equipped operating room. Of necessity modifications of arrangement to suit the available space is permissible. For instance, the instrument case is, in many institutions, placed in an adjoining room; however, if the operating room is sufficiently large, it had best be kept there, with the view of obtaining without delay instruments which have either been forgotten by the assistant or which may be called for to meet an unforeseen contingency. The delay of sending out of the room a nurse during the operation for the purpose of obtaining an instrument or appliance is objectionable.

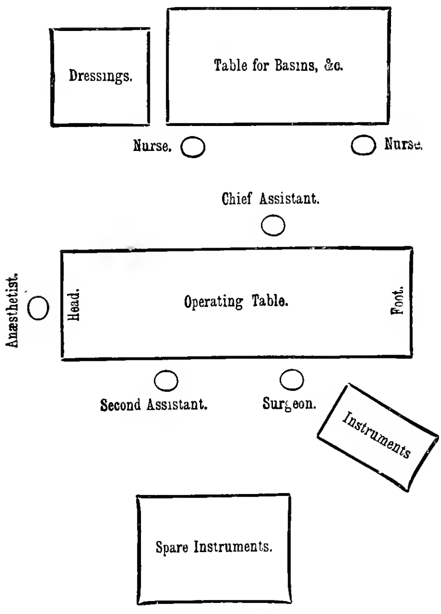


Fig. 98.—Diagram of Arrangement of Apparatus and Assistants During a Celiotomy Operation. (*Bryant.*)

DRESSING OF TABLES IN OPERATING ROOM

The Operating Table.—The glass surface of the operating table presents a hard surface for the patient to lie on. While it would

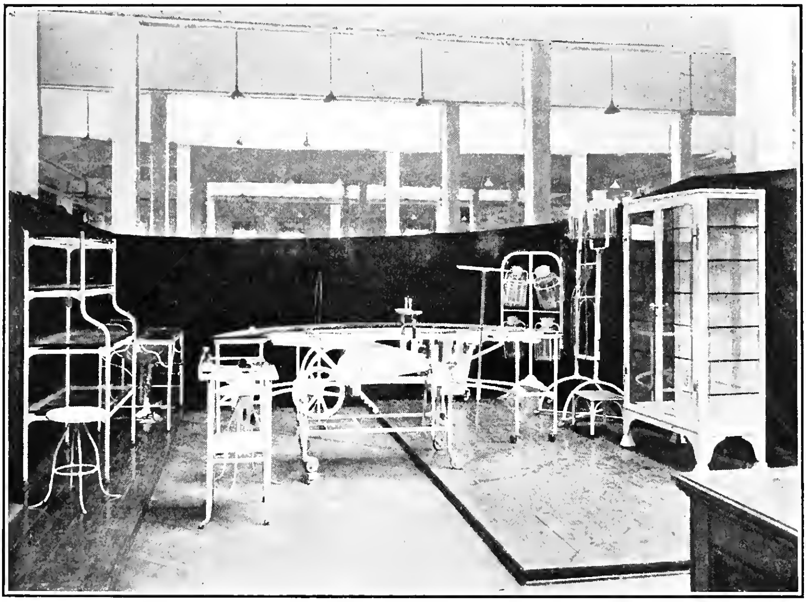


FIG. 99.—TABLES, ETC., USED IN OPERATING ROOM.

conserve perhaps best both cleanliness and drainage to place the patient immediately upon the glass surface of the table, it has

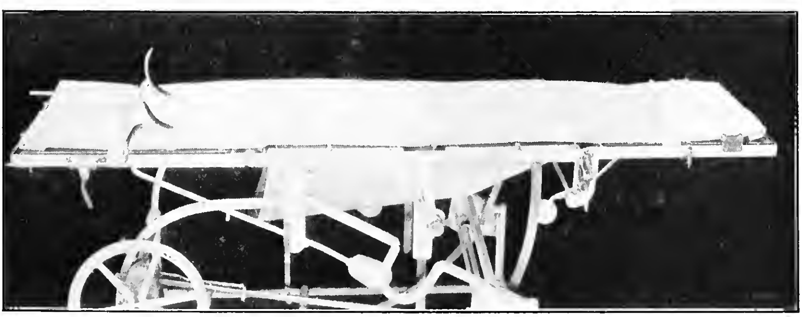


FIG. 100.—OPERATING TABLE COVERED WITH PADS.

been found that the subsequent discomfort to the patient, the outcome of prolonged contact with a hard surface, is exceedingly objectionable. To obviate this, the table is covered with two pads composed of cotton which are incased in rubber sheeting and then covered with a linen case to fit the pad. These are fastened to the operating table with tapes (Fig. 100), an arrangement which does not interfere with drainage, and the linen cases are removed and replaced with fresh ones after each operation, conserving cleanliness.

The Instrument Table.—The instrument table is covered with a sterile towel (Fig. 101) or sheet, and the instruments after

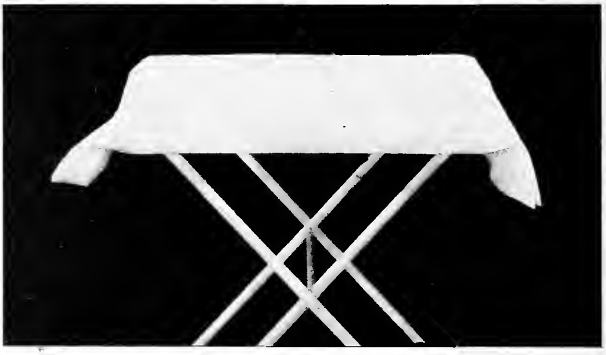


Fig. 101.—Instrument Table Covered with Sterile Towel.

being taken from the sterilizer are placed upon it. Fig. 102 shows a serviceable arrangement in this connection. In this instance two tables are placed contiguous to each other and covered with a sterile sheet. Upon the sheet sterile towels are placed, which may be replaced when this set becomes soiled. A pan of sterile water of moderate temperature is placed beside the instruments for two purposes: first, the instruments as they come from the sterilizer are very hot and cannot be handled. If they be submerged for a few minutes in cool sterile water this is obviated; and, second, during operations, the instruments become soiled and may be cleansed in the sterile water, thus permitting of easier manipulation than obtains when instruments are slippery from a coating of blood or secretions. Fig. 103 shows the pan with a portion of the instruments submerged for the purpose mentioned.

The Anesthetist's Table.—The anesthetist's table need not be protected by sterile material unless the operation involves the head and face. Fig. 104 shows the arrangement universally

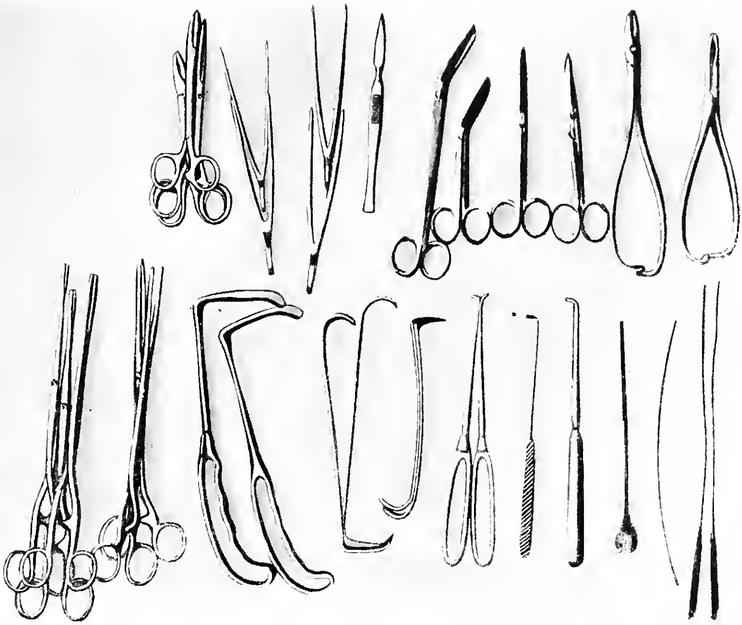


Fig. 102.—Instruments Spread on Sterile Towel, Ready for Use.

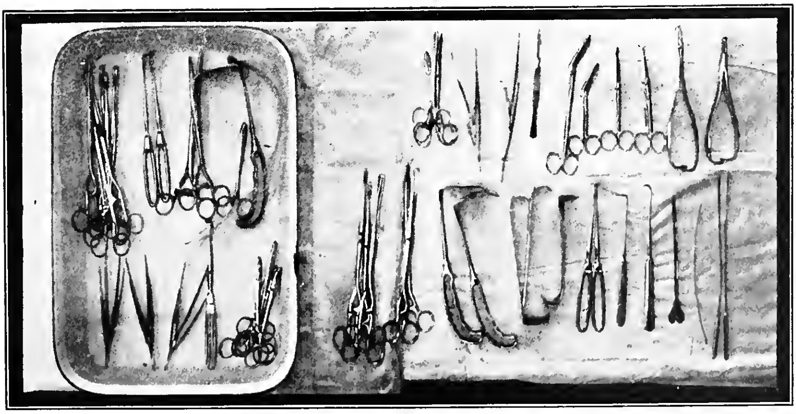


Fig. 103.—Instruments Ready for Use, a Portion of Which are Submerged in Sterile Water.

found useful. The modified *Esmarch* mask is used in the writer's cases for the administration of ether by the so-called open method, and if for any reason chloroform is to be used, it may be dropped on the same apparatus.

The chloroform and ether bottles and bottles containing stimulants are placed together. The pus basin is used for receiving the vomit, and the hypodermic syringe is placed in a glass receptacle submerged in carbolic acid solution (1-40). Besides this a grad-

Fig. 104.—Table Arranged with Material Necessary to Narcotist.

uate and a glass containing small squares of gauze are kept on hand, the latter being employed to moisten the patient's lips or wipe out the pharynx. For the latter purpose a sponge holder, shown in the illustration, is employed. Besides this a *Whitehead* mouth gag, a tongue depressor, and scissors should be placed ready for use. The two towels are intended to be used as necessity arises, though the gauze seen in the pus basin will serve all purposes for which towels are ordinarily employed. However, the greater absorbing capabilities of the gauze recommends its use in preference to the towel, though the latter may become of service in the event of profuse vomiting.

The Adjustable Instrument Tray.—The adjustable tray is first covered with a sterile pillow slip, which is tucked about the stand

(Fig. 105). Upon this a sterile towel is placed, and the instruments in immediate use are laid upon this (Fig. 106). From

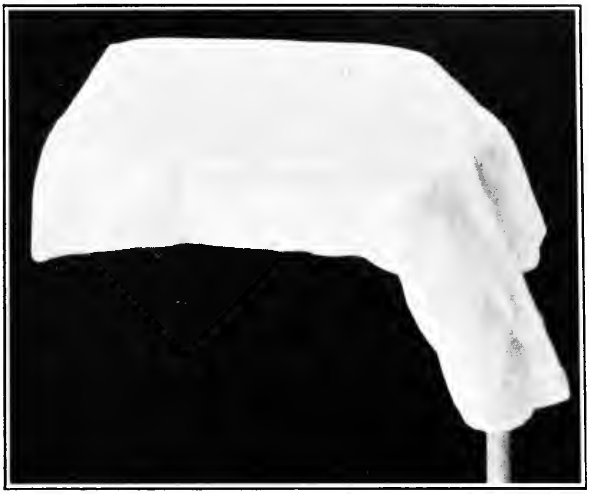


Fig. 105.—Adjustable Instrument Tray Covered with Sterile Pillowcase Tucked About Stand.

time to time the assistant in charge of the instruments replaces various tools with duplicates and cleanses the former, holding

Fig. 106.—Adjustable Instrument Tray with Sterile Towel and Instruments in Immediate Use.

them ready, upon the larger table (Fig. 102), to take the place of the set in use when occasion arises. From time to time the nurse changes the sterile towel without disturbing the sterile pillow case.

Dressing Table.—The table for dressings, wipes, etc., is in-

Fig. 107.—Dressing Table Arranged for Extensive Operation or when Several Major Operations are to be Performed in Immediate Sequence.

tended to hold material handled by the sterile nurse. Fig. 107 shows a table dressed for an extensive operation or for several operations to be performed in rapid succession. The jars contain medicated gauze, sterile absorbent cotton, and sterile gauze bandages. The packets contain sterile gauze, wipes, and abdominal pads. Beside this, the table holds sponge holders, two glasses for emergency, and a basin with sterile water for the purpose of rinsing soiled sponge holders.

This is the arrangement which the writer employs. However, immediately after the various materials have been disposed upon the table, they are covered with a sterile sheet (Fig. 108), and when anything is to be used the nurse lifts the edge of the sheet and obtains it. This lessens the chances of accidental contamina-

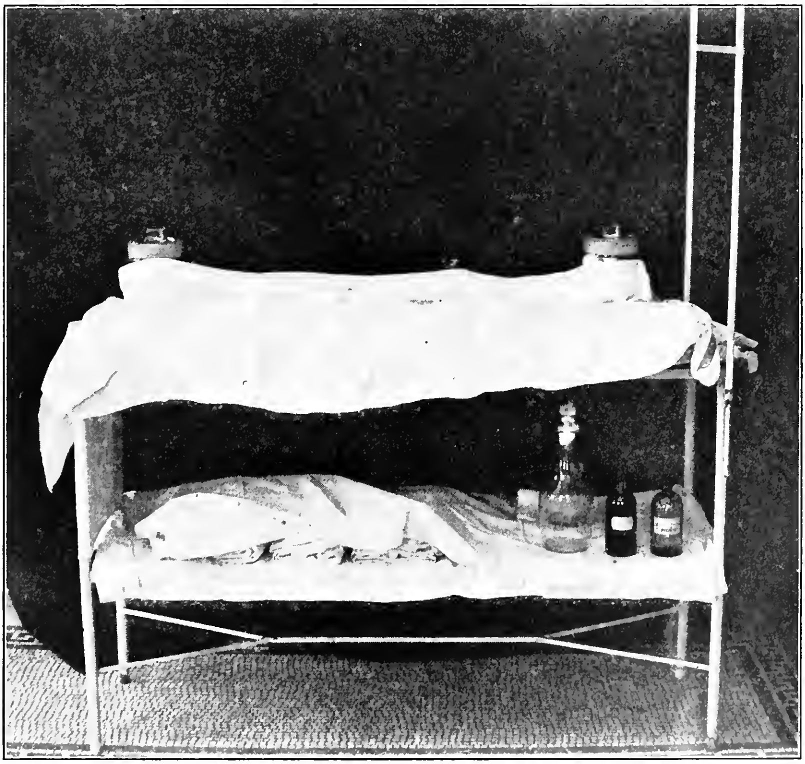


Fig. 108.—Dressings, Etc., Protected by Sterile Sheets.

tion from dust or other sources, such as sputtering of cleansing solutions which have been forcibly projected against the wound area. The jars, of course, need not be covered, as they are opened only when a portion of the contents is removed and the covers are immediately replaced.

Fig. 109 shows a table which is arranged for operations in small sanitaria, where a single assistant handles towels, dressings, instruments, and solutions. The table is fitted with a frame over which sterile towels are laid. The latter are usually submerged in sublimate solution after being boiled with the view of preventing contamination from surroundings. The tray holding towels and dressings are of agate-covered metal, and while not as clean-looking as the white enameled ones holding instruments, are just as useful for the purpose. The spirit flame is intended for the

Fig. 109.—Table Arranged with Instruments and Dressings Suitable for Small Sanatoria.

heating of instruments which may have become accidentally contaminated. The writer has found this arrangement exceedingly satisfactory, especially when the number of assistants is small. The larger glass jar contains rubber gloves, and the glass carafe solution prepared in the manner shown in Figs. 138 and 139.

FINAL PREPARATION OF PATIENT

The preparations just related take place while the patient is still in the contiguous chamber being narcotized. The description following is based on the steps taken when celiotomy is made, but is equally applicable to operations on other portions of the body. In hospitals and institutions the patient after being properly attired (Fig. 15) is placed on a carriage upon which he is finally trans-

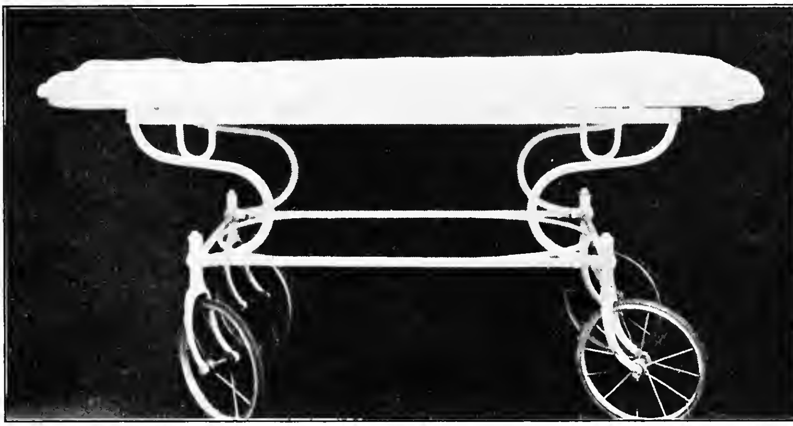


Fig. 110.—Carriage for Transportation of Patient to Operating Room, Covered with Pad.

ported to the operating room. This carriage is of enameled steel, the top of which is padded with a folded blanket enveloped in a

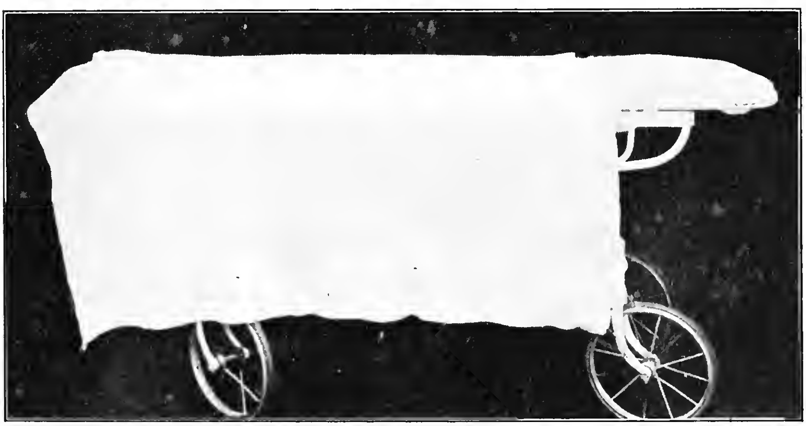


Fig. 111.—Carriage Covered with Blanket and Small Pillow.

sheet (Fig. 110). A blanket is draped over this, and a flat pillow placed at one end for the patient's head (Fig. 111). Upon this a sheet, folded into a square, is placed so as to correspond to the thorax and abdomen of the patient (Fig. 112). This is used to lift the patient from the carriage to the operating table.

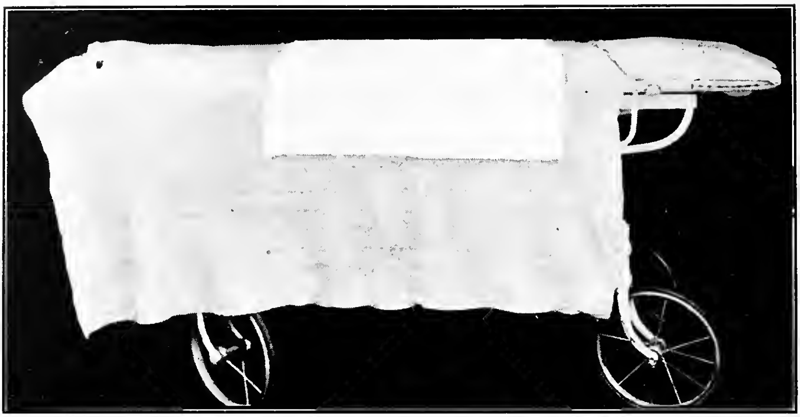


Fig. 112.—Carriage with Folded Sheet over Blanket.

Fig. 113 shows the patient as he lies on the folded sheet and blanket. A large sheet is now tucked about the patient in the manner shown in Fig. 114, which is of assistance in controlling

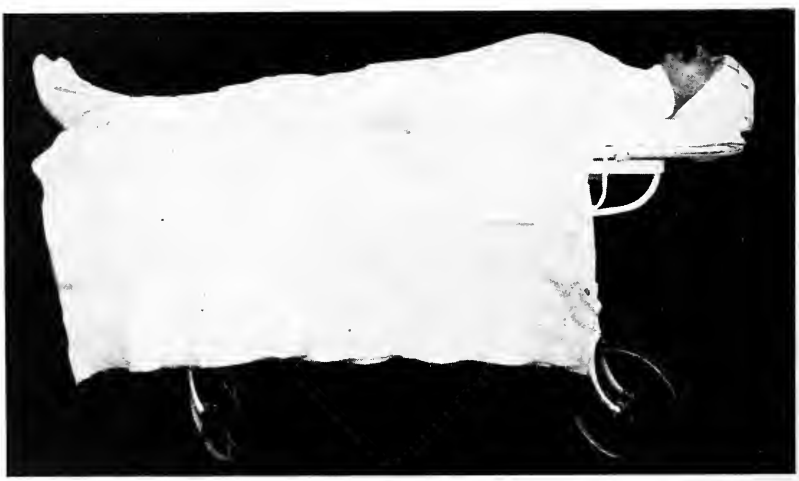


Fig. 113.—Patient Placed on Carriage.

the struggling which occurs quite often at the beginning of narcosis.

The sheet and blanket are now folded over the body, and a second short blanket is thrown across the thorax, as shown in Fig. 115. When the patient is narcotized he is wheeled into the operating

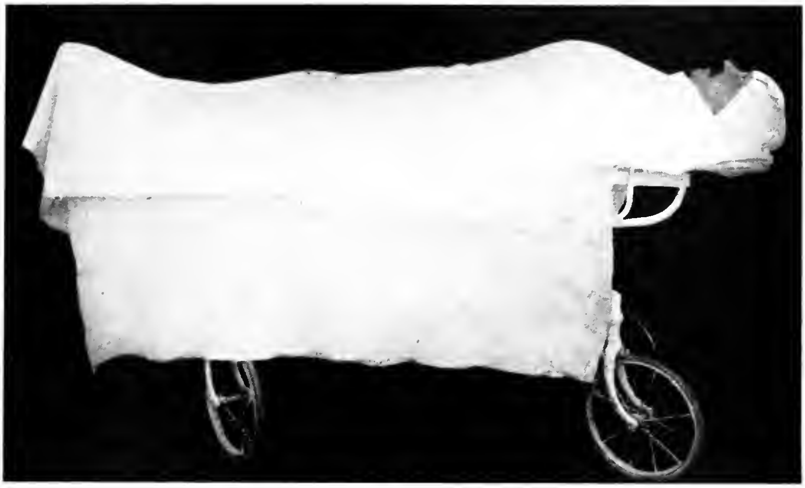


FIG. 114.—RESTRAINING SHEET PLACED ABOUT PATIENT.

room, the blankets and sheet are unfolded, and he is lifted with the aid of the short sheet (Fig. 112) to the operating table. The part to be operated upon is now exposed, and the contiguous portions

FIG. 115.—PATIENT COMPLETELY PREPARED FOR NARCOSIS AND SUBSEQUENT TRANSPORTATION TO OPERATING ROOM.

of the body covered with folded blankets (Fig. 116), which are covered with rubber sheets (Fig. 117) to protect the latter from moisture.

The assistant now proceeds to give the part the final preparation. For this purpose the nurse has prepared a bottle of sterile

Fig. 116.—Surrounding Parts of Operative Field Covered with Woolen Blankets.

tincture of green soap, a mixture of alcohol and ether, a flask of solution of bichlorid of mercury 1 in 1,000, and another containing sterile water. These are conveniently arranged on a tray or table (Fig. 118). The flasks are both stoppered with cotton, and the one containing the mercury solution has a small label affixed for purposes of identification, though it would be best to have the mercury solution colored blue.

The assistant, who wears gloves and has not yet donned his sterile gown, gently scrubs the skin with tincture of green soap and sterile water poured on the skin by the non-sterile nurse. This is displaced with sterile water from the flask, and the solution of alcohol and ether poured over the surface. The object of this application is to dissolve the grease from the sebaceous glands

Fig. 117.—Woolen Blankets Protected from Moisture with Rubber Sheets.

not removed by the scrubbing. The ether and alcohol are removed with a copious quantity of water poured from a pitcher, as shown in Fig. 71. The temperature of the water used for this purpose should be about 80° F., in order to prevent burning of the skin on the dependent portions of the body.

The non-sterile nurse now lavages the part with the bichlorid solution, and this is finally displaced with a large quantity of sterile water.

A useful method of sterilizing the skin preliminary to operations under local anesthesia is employed by *Grossich*. A ten or twelve per cent. iodin tincture is applied to the field of operation and surrounding skin, with a brush, without any preliminary scrubbing. The microscope has shown that the tissues take up the iodin much more readily when dry, and that it penetrates deeply into all the nooks and crevices, which does not occur with the usual preliminary scrubbing with soap and water. The water macerates

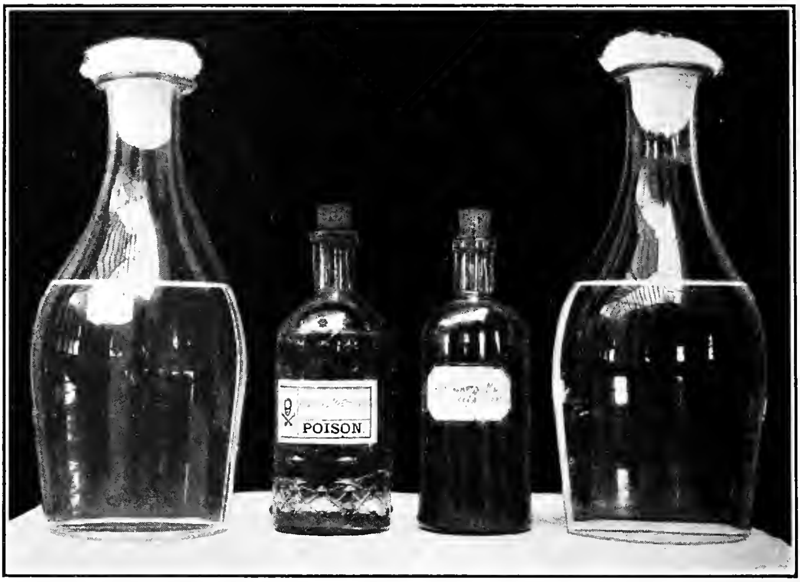


Fig. 118.—Convenient Arrangement of Articles Necessary to Final Cleansing of Skin with Patient on Operating Table.

the epidermal cells, causing them to plug the openings. The parts are shaved, dried and then painted with the iodin. After anesthesia is produced, the field of operation is again painted with tincture of iodin, and finally the completed suture is again swabbed with it. *Grossich* states that if the iodin is applied after the parts have been recently scrubbed with soap and water, there is liable to be suppuration. It is indispensable that the tissues should be dry when the iodin is applied.

The assistant removes the rubber gloves, rinses his hands in sterile water, puts on the gown, incases the hands in fresh gloves and has the nurse put the mask in place.

The rubber sheets are covered at the ends nearest the operation field with sterile towels (Fig. 119), and the patient covered with the celiotomy sheet, which is provided with an oblong opening to correspond to the part to be operated upon (Fig. 120). It is necessary that the sheet be of sufficient dimensions to drape well down

FIG. 119.—RUBBER SHEETS COVERED WITH STERILE TOWELS.

over the sides of the operating table (Fig. 121). The field of operation is protected additionally by four sterile towels fastened together in the manner shown in Fig. 122, which are placed *in situ* as shown in Fig. 123. This arrangement allows of the removal of the square of towels when soiled and its replacement at necessary intervals during the operation without disturbing the underlying sheet.

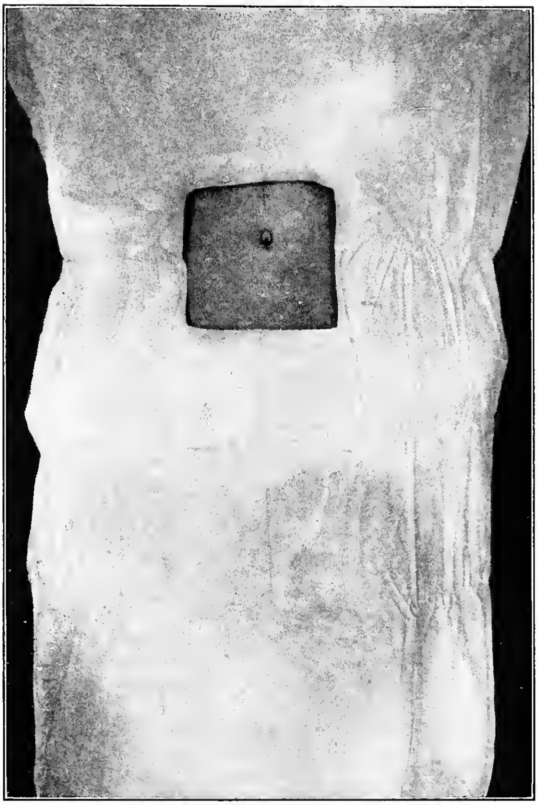


Fig. 120.—Operative Field Isolated by Celiotomy Sheet.

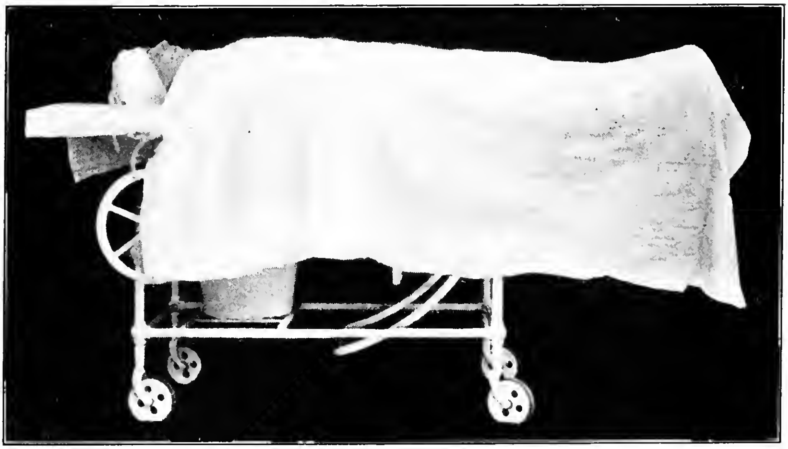


Fig. 121.—Side View of Arrangement of Celiotomy Sheet.

DISPOSITION OF OPERATOR, ASSISTANTS AND NURSES DURING THE OPERATION

The relationship of the assistants during the operation to the field of operation should be considered from the view point of expediency and with the view of forestalling infection.

The prime consideration is that of not permitting any of the assistants or the apparatus to interfere with the source of light. In operations on the abdomen the head of the patient should be turned toward the light if the *Trendelenburg* posture is to be employed, and the feet point toward the light if the patient is to remain flat throughout the operation. In the former instance the assistant administering the narcosis is liable to throw a shadow on the field of operation, if there has been no provision made for reverse illumination as described. However, this obtains only during the first portion of the operation when the patient is still lying flat. When the Trendelenburg posture is assumed the patient's abdomen will be higher than the head of the assistant administering the narcosis, if he be seated (which he should be), and the difficulty mentioned is overcome. This calls for a source of light as high up as is feasible, and in all operations this should be borne in mind. The illustration (Fig. 124) shows a serviceable arrangement of tables and assistants.

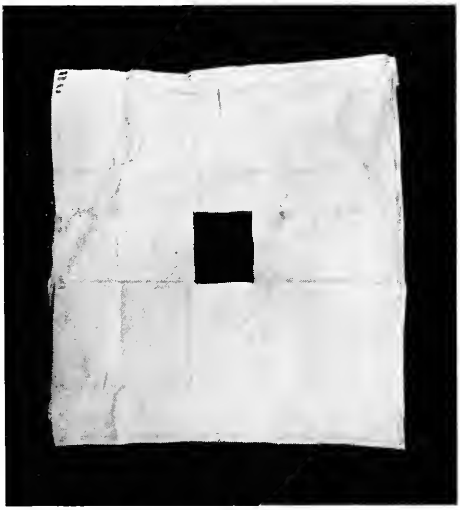


Fig. 122.—Sterile Towels Arranged in Manner to Surround Operative Field.

THE OPERATING ROOM IN PRIVATE PRACTICE

Using the description of the operating room as described as a standard, as nearly as possible an arrangement should be attempted when operating in private practice. As already stated, sterile material for wipes, dressings, sterile towels and dressings are obtainable in the market, packed in impervious packages, which simplifies very much the problem. If the surgeon have not at his command apparatus which will sterilize with certainty this class of material, it is best to obtain it in the market. As regards the

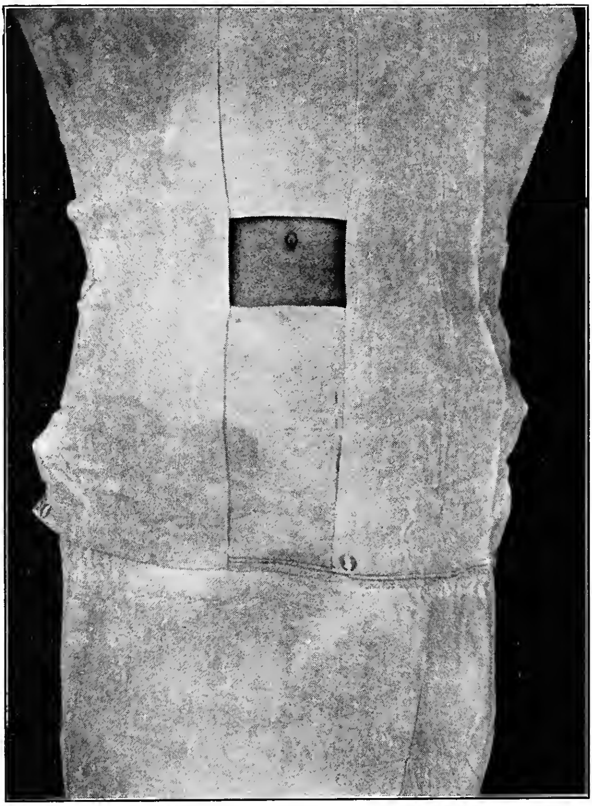


FIG. 123.—STERILE TOWELS APPLIED TO SURROUNDINGS CONTIGUOUS TO OPERATIVE FIELD.

technic of sterilization, this has already been described (page 62).

Towels and sheets are perhaps less readily obtainable than dressings, and it is, under these circumstances, at times necessary to meet the indications in another way. The writer has obtained favorable results as regards asepsis in private practice by baking towels and sheets and gowns in the kitchen oven, followed by

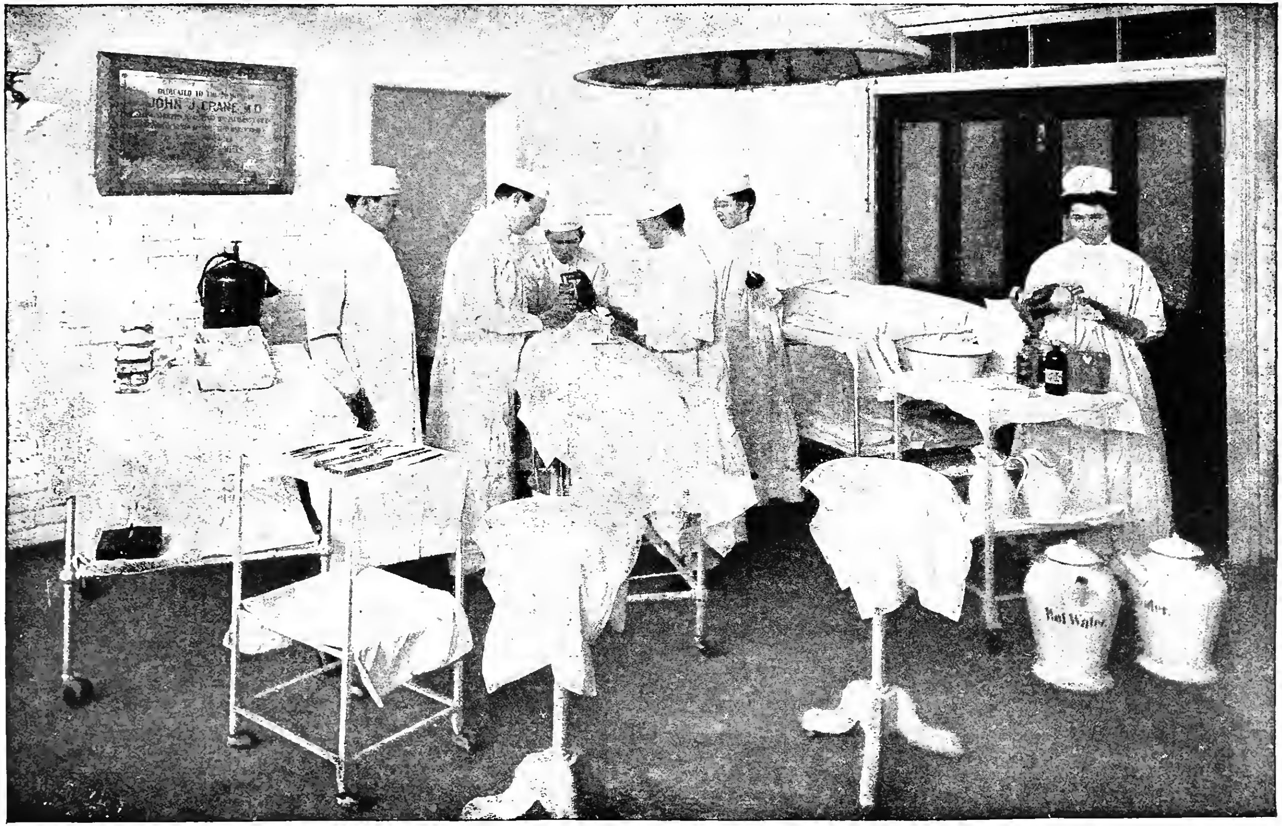


FIG. 124.—PREPARED FOR OPERATION. (*Bryant.*)

immersion in hot bichlorid solution 1 in 1,000 for twenty minutes. This necessitates the wearing of a wet gown, which is exceedingly uncomfortable; however, this is a minor objection. Certain it is that neither the gowns nor towels or sheets may be regarded as sterile as the outcome of the baking process. Again, the contact of the mercury solution with instruments destroys them, though this, too, is a minor consideration.

It is to be borne in mind that aseptic results are more readily obtained in private practice than in even the best equipped hospitals, though the technic of asepsis seems not to be so thorough. This is perhaps due to the probable absence of pyogenic bacteria in private residences as contrasted with hospitals, where infected cases are frequently operated upon.

This consideration, however, should not engender a complacency which may be the causative factor in an unfavorable outcome. The chamber selected for the performance of the operation should be well lighted and the arrangement of the necessary apparatus so designed as to interfere as little as possible with this desideratum. A room sufficiently large for the purpose is likely to have two windows, though one of slightly less dimensions with one large window is preferable, as the operating table is best placed in the center of the room, and the shadow of the space between the two windows falls on the table if it be thus placed. If a room with two windows is used, it is best to have the table stand in the zone of light from one of them and arrange the accessory paraphernalia accordingly.

The curtains and shades should be removed from the windows to avoid obscurity of illumination from this cause, though their removal is imperative for other reasons. To avoid the espionage of curious neighbors the window glass may be covered with a thin layer of soap applied with a piece of gauze. This prevents outsiders from looking into the room and does not interfere markedly with illumination. If the room is to be prepared on the same day as the operation, care must be taken not to make sufficient upheaval in the set arrangement of the room to provoke dust which will not have time to settle by the time of the operation.

In this instance the curtains, shades, hangings, all furniture and pictures should be carefully removed, taking the precaution of wiping them off with a damp cloth before manipulating them.

The carpet should not be removed, but may be covered with sheets dampened with a solution of mercuric chlorid 1 in 1,000. The walls should be gently wiped with gauze moistened with the corrosive sublimate solution.

If the operation is to be performed more leisurely, the pictures, shades, hangings, furniture, including carpets and ornaments, are removed, the walls dusted and the windows left open for several hours, during which the dust is permitted to settle. The room is then fumigated by burning sulphur after it has been carefully sealed. All windows, doors and chimney joints are sealed with gummed paper or adhesive plaster strips. The sulphur is ignited at night and the resulting fumes permitted to remain in the chamber until the following morning. The room is then opened, the seals removed and fresh air admitted. The walls, ceiling and floor are thoroughly wiped with the solution of bichlorid of mercury 1 in 1,000, using a large piece of gauze for the purpose. When the mercury solution contained in a piece of gauze is exhausted, it is thrown away and a clean piece used. The assistant who does the wiping should be admonished not to rub a certain area of room with a piece of gauze and then resoak it in the solution, but to throw it aside and use a fresh supply. The floor is scrubbed with green soap and hot water. The mantel and stationary furnishings may be covered with clean sheets. The latter preparations should be completed for several hours before the operation. In the interim no one should be allowed to enter the chamber except those directly concerned in the operative procedure.

THE OPERATING TABLE

The transportation of an operating table permitting of the elasticity given by the kind of apparatus in use in hospital or office practice is impracticable. To overcome the discomfort of the improvised table, manufacturers at the instigation of surgeons have made portable tables which in all essential regards meet the indications. A number of these portable tables are on the market, each one of which has its exponents, and, indeed, each one presents certain advantages over the other.

Portable Operating Table.—The table shown is one designed by Dr. J. Bently Squiers of New York City, constructed of cold-drawn steel tubing fitted with milled tool steel rack and pinion

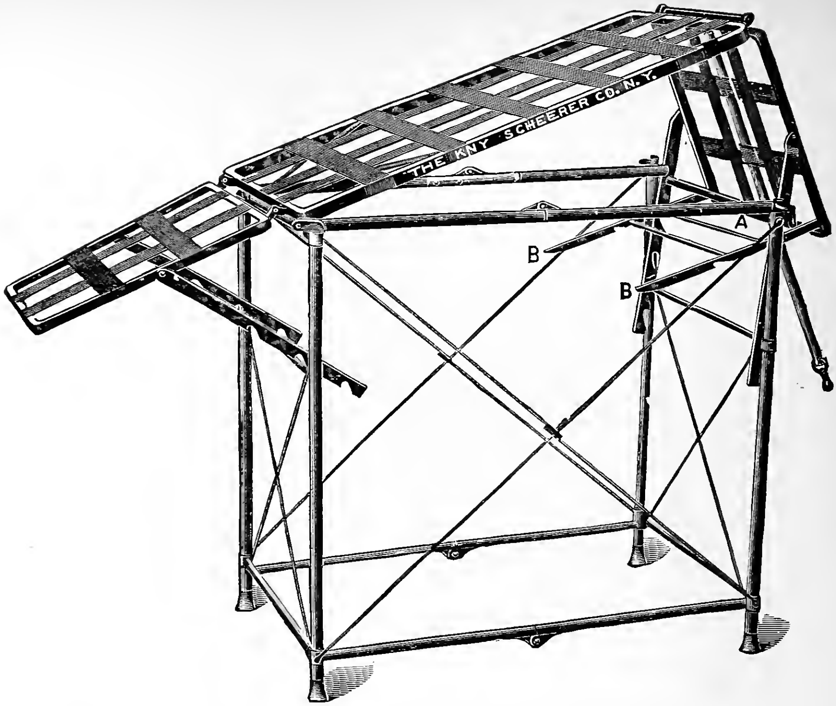


FIG. 125.—SQUIERS' PORTABLE OPERATING TABLE, SHOWING TRENDELENBURG POSTURE AND CRANK FOR OBTAINING SAME.

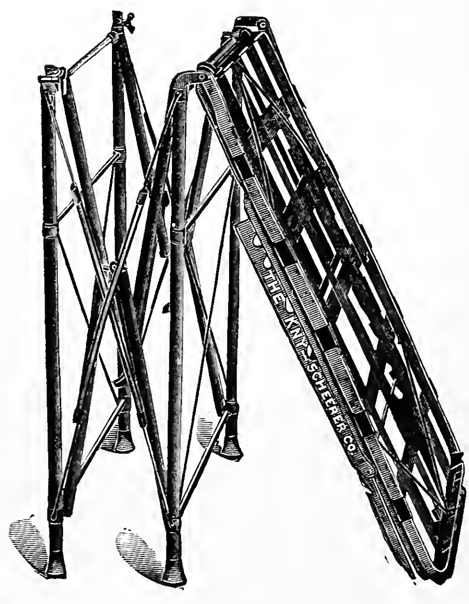


FIG. 126.—METHOD OF FOLDING SQUIERS' PORTABLE OPERATING TABLE.

with crank for elevating the top (Fig. 125). To fold the table (Fig. 126) it is only necessary to fold back the top, which is hinged together, bend the hinge in the center of the bottom braces, which fold, and the two ends slide together by the side braces folding. There is no fastening of screws or clamps necessary to set up or fold the table. When folded for transportation the table appears as shown in Fig. 127. The case (Fig. 137) is extremely

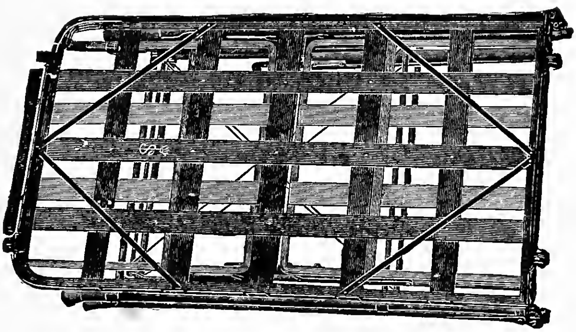


FIG. 127.—SQUIERS' PORTABLE OPERATING TABLE FOLDED FOR TRANSPORTATION.

light and is fitted with a handle. The weight of the table is 28 pounds. The Trendelenburg posture is shown in Fig. 125. For operations on the head and face the head-piece is raised or lowered as desired; the arrangement for lithotomy position is shown in Fig. 128. The dimensions of the table are 19 inches wide, 67 inches long and 34 inches high. When folding for transportation, the dimensions are 6 inches thick, 20 inches wide and 35 inches long. This table may be regarded as forming a standard. Modifications of construction to suit the taste and class of practice of the surgeon are simple questions of mechanical art.

The portable apparatuses designed to be placed on the ordinary deal table to permit of Trendelenburg posture, lithotomy position, etc., are also much in vogue. These are extremely useful and satisfactorily efficient, if it be not necessary to change the posture of the patient during the operation. The disturbance of the arrangement of the sterile surroundings consequent upon the manipulations involved under these conditions makes them less acceptable than a table fitted with legs, as the Squiers table or a similar apparatus.

The additional weight of the frame and legs is a minor consideration. On general principles a portable table should be designed with the view of obtaining the greatest elasticity as regards necessities which may arise, and there can be no doubt that the kind of table here described is constructed with this in view.

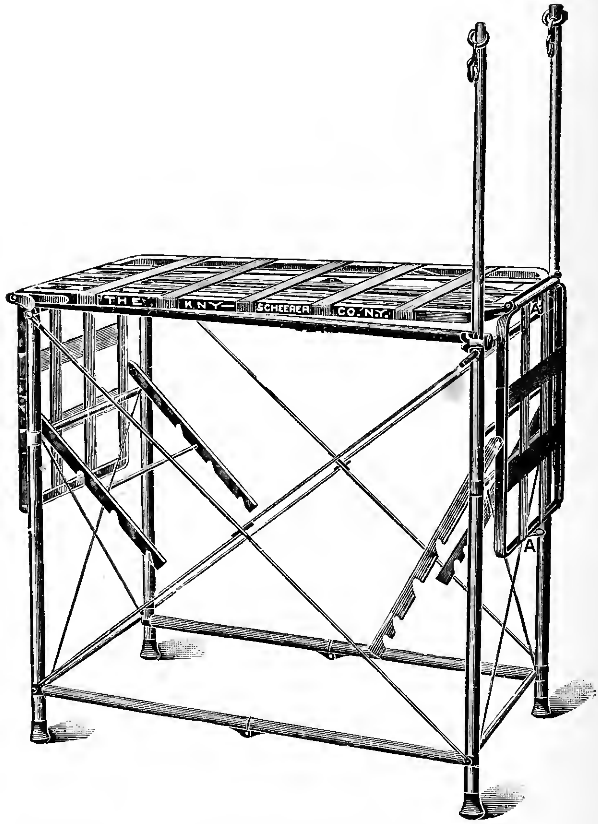


Fig. 128.—Squiers' Portable Operating Table Arranged for Lithotomy Position.

An operation for removal of a neoplasm of the neck which is to be performed in the patient's home calls for neither a portable complete table nor an adjustable frame, and in this instance the ordinary deal table is of sufficient utility. Indeed, it may be said that the display of unnecessary armamentarium in surgical work is undesirable; yet the portable operating table is well nigh indispensable in operations on the abdominal and pelvic organs.

The Extemporized Operating Table.—For this purpose the ordinary deal kitchen table makes a useful substitute in operations

Fig. 129.—Extemporized Operating Table. Kitchen table covered with blanket.

which permit of the supine position and may be tilted to obtain a moderate degree of Trendelenburg elevation. However, it is to be remembered, as already stated, when the Trendelenburg posture

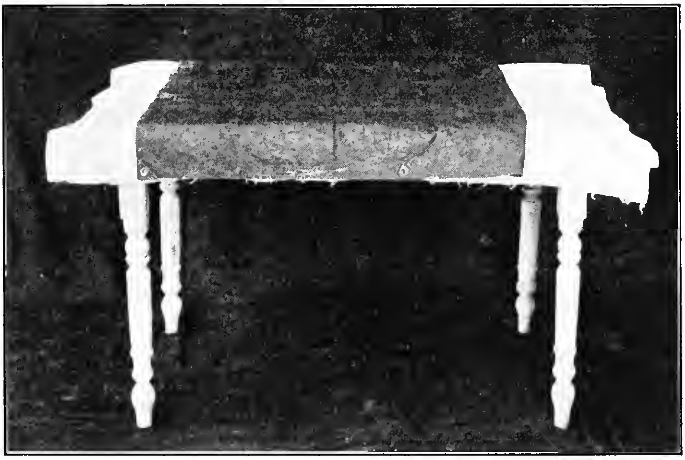


Fig. 130.—Extemporized Operating Table Covered with Blanket and Rubber Sheet.

or the lithotomy position is necessary, special apparatus for the purpose should be employed.

The deal table usually found in kitchen or laundry is more useful than the dining-room table, as the latter is likely to be too

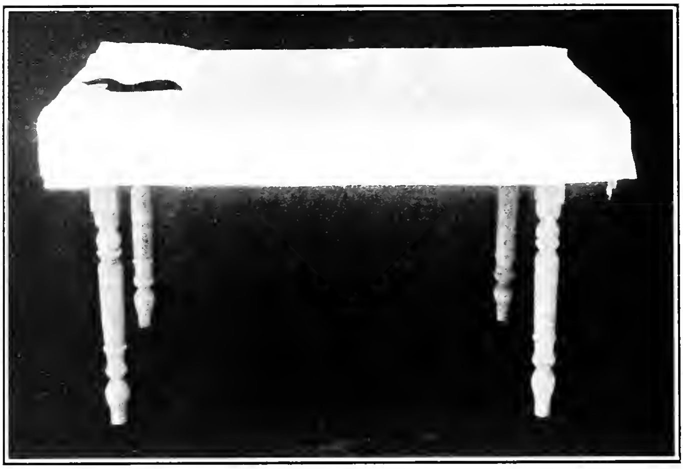


Fig. 131.—Small Pillow and Sheet Placed on Extemporized Operating Table.

wide to allow of easy access to the patient from both sides. The kitchen table should be covered with a folded blanket (Fig. 129)

Fig. 132.—Drainage Pad Placed on Extemporized Operating Table.

in order to prevent pressure soreness following the operation. Next a rubber sheet (Fig. 130) is placed on the blanket and this covered with a sheet and a small pillow (Fig. 131) placed *in situ* for the patient's head. Drainage is provided with the Kelly pad (Fig. 132), the pad being, of course, placed on the portion of the table corresponding to the part to be operated upon. The bottom of the

Fig. 133.—Kelly Pad Arranged on Extemporized Operating Table, to drain into Pail.

pad is folded over and led into a pail (Fig. 133). Care should be exercised in selecting a table with firm strong legs, as the combined weight of the patient and the fact that the operator and assistant are likely to lean on the table are apt to break the legs off where they join the top. If there be any doubt as to the stability of the table, it may be reinforced by wiring the legs together near their bottoms.

If the lithotomy position is to be employed, the apparatus shown in Fig. 134 will be found extremely useful. The clamps are readily fastened to any table and the uprights are maintained at any height by means of the set screws. At subsequent dressings, the clamps may have the stirrup shown in Fig. 135 inserted instead of the upright.

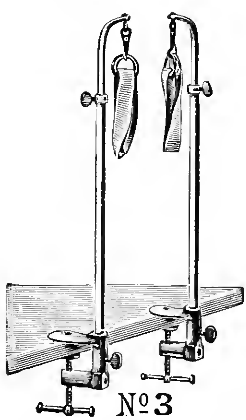


Fig. 134.—Clamps and Uprights for Lithotomy Position on Extemporized Operating Table.

Tables for narcotist, suture material, instruments and dressings are readily extemporized from those ordinarily found in dwellings. As a matter of fact, the operating table and one table (Fig. 136) are perhaps the only portable apparatuses necessary. Fig. 137 shows a case which will carry both the portable operating table and the small metal table for instruments, which may be placed close to the surgeon and take the place of the adjustable instrument tray.

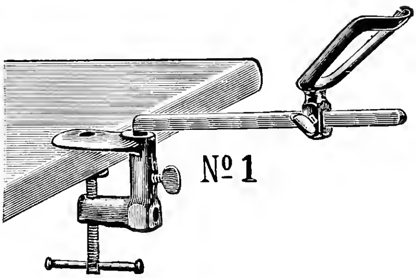


Fig. 135.—Clamp and Stirrup for Extemporized Operating Table.

Dressings, wipes, etc., have already been taken up (page 158). Their disposition in the improvised operating room need not differ materially from that which obtains in hospital operating rooms.

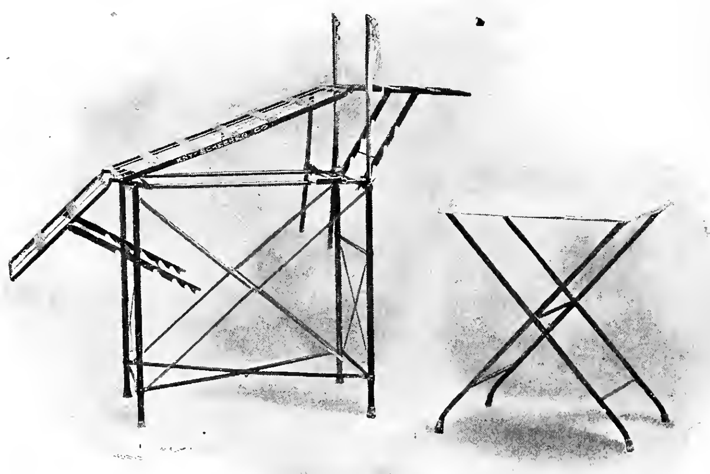


Fig. 136.—Portable Operating and Instrument Table.

STERILE WATER

The question of sterile water is not solved by the presence of several gallons of distilled water. Distilled water, as already stated, is not sterile, though boiled water which is used soon after boiling is practically sterile. In this contingency it is well to boil the distilled water in a large wash boiler and to fill the pitchers with a dipper which has been boiled with the water. Frequent immersion of the hand into the wash boiler in order to manipulate the dipper is objectionable. This may be obviated by the use of a dipper with a sufficiently long handle to protrude over the top of the boiler, a corner of the boiler cover being notched for the

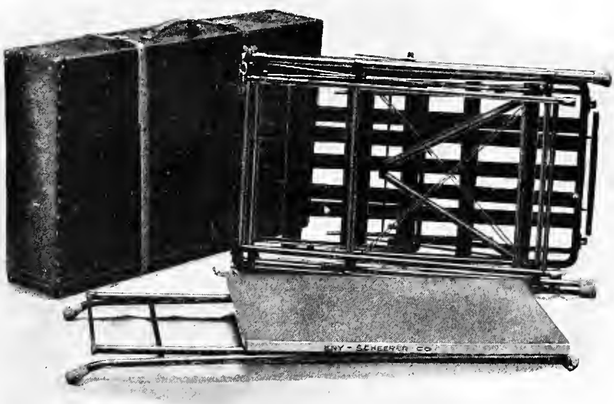


Fig. 137.—Portable Operating and Instrument Table Folded for Transportation, and Case for Same.

purpose, though this should not be done until after the boiler has been exposed to high temperature.

An exceedingly useful method of handling water is used by *Lesser*. A flask of thin glass, especially prepared to withstand high temperature, is filled with distilled water and the mouth covered with cotton between two layers of gauze (Fig. 138). The neck of the bottle has a piece of wire twisted about it, by means of which it is suspended when used as an irrigator. A number of these bottles are placed directly on the fire (Fig. 138), and the water boiled for twenty minutes. A Bunsen burner may be used, or the flask may be placed on the kitchen stove. For the purpose of lavaging the parts the non-sterile nurse simply lifts

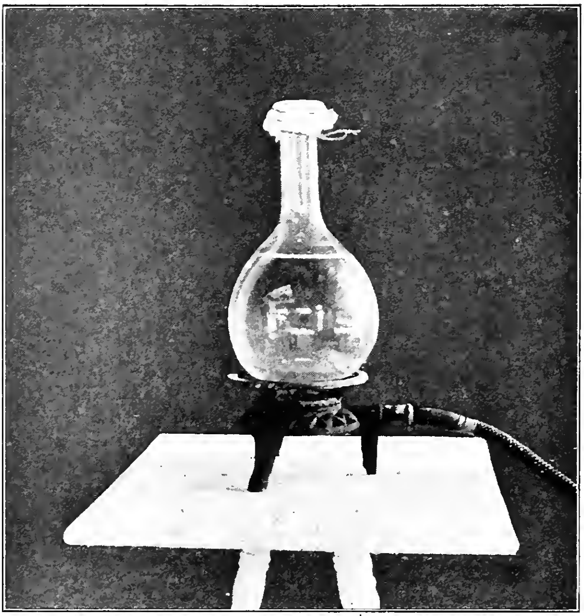


Fig. 138.—Flask Filled with Water, Which is Boiled for Twenty Minutes Immediately before Use.

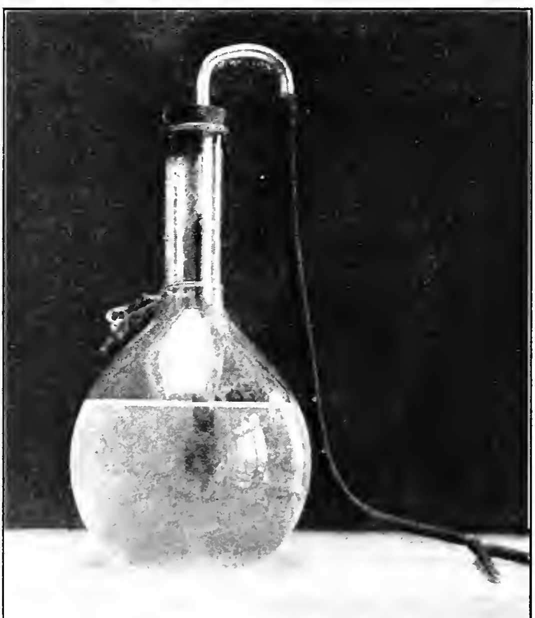


Fig. 139.—Flask of Sterile Water with Rubber Tube Connection for Irrigation.

the gauze cover and pours the contents on the surface to be cleansed. For irrigation the cotton plug is removed and a rubber cork pierced with a bent glass tube is substituted. The portion of glass tube in the bottle is connected with a piece of soft rubber tubing, the end of which is covered with gauze for the purpose of avoiding the abstraction of foreign particles in the event of the water not being distilled. If the water has been distilled the gauze screen is not used.

Fig. 140.—Glass Bulb Connection in Rubber Tube to Control Flow of Irrigating Fluid.

The portion of glass tube protruding is connected with a long piece of rubber tubing (Fig. 139). To withdraw the water, the tubing and glass tube and cork are submerged in sterile water and filled. This constitutes a siphon, and the connection with the reservoir is made as shown (Fig. 139). The tube is closed with a clamp when not in use. Midway between the bottle and the terminal end of the rubber tubing is connected a glass tube with a bulbed enlargement. This gives opportunity for standardizing the flow of water in washing into cavities. It also permits of recognition of the flow in itself, thus obviating the annoyance of doubt as to whether the fluid is flowing or not. Fig. 140 shows the bulb connection, which in this instance was partially filled with a solution of potassium permanganate to favor clearness in the illustration.

Fig. 141 shows the irrigating apparatus suspended from a stand. In private practice an ordinary clothes hook placed in a convenient situation may be employed. The basin near the bottom of the stand is filled with a solution of bichlorid of mercury 1 in 1,000. In this instance the bulb is submerged in the basin. Care must be taken not to contaminate the tube connections when the siphonage is arranged.

The advantage of the method lies in the fact that the water is sterilized in the container, from which it is delivered on the operative field without intermediate handling.

Theoretically this method of sterilizing and employing water should be more certain than one which involves handling of the water between the sterilizer and the wound. However, the inflexibility of the method with respect to the adjustment of desirable ranges of temperature, and the fact that the apparatus now employed for the purpose is so well arranged, would argue for employment of the latter in hospitals and sanatoria, leaving the flask method for use in private practice.

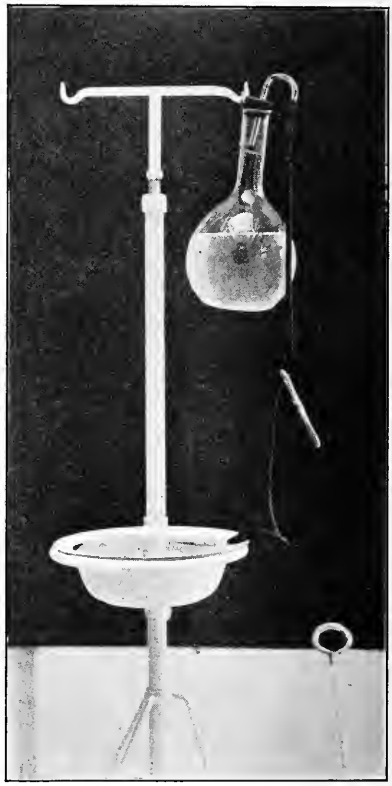


Fig. 141.—Flask Used as Irrigator Suspended by Wire Attached to Neck.

It is of course feasible to sterilize water by other means than those shown here. For instance, there is no reason why containers other than those made of glass should not be employed for the purpose, provided the principle of not handling the water after it is boiled is borne in mind. In the event of the water thus treated being too hot, the flasks may be immersed in cold water for varying periods of time, in accord with the desired temperature. It is a good plan, if feasible, to boil all the flasks twenty-four hours before the operation and heat half of them, to almost the boiling point, immediately before the operation. Thus the surgeon has at his disposition water of quite extreme temperature, a condition of affairs which permits of considerable adjustability in this connection.

SUTURE AND LIGATURE MATERIAL

Suture and ligature material in private practice is used in the same form as obtains in hospital practice. However, the transportation of suture material which will not stand boiling is unsafe, unless it be inclosed in sterile tubes (Fig. 53). Silk, silk-worm gut and celluloid thread (*Pagenstecher* thread), may be safely transported and boiled with the instruments or separately. It is to be borne in mind that iodine catgut will not stand heat, and, if used from sealed tubes, the tubes must be sterilized by prolonged immersion in strong antiseptic solutions, which latter may be diluted with sterile water immediately before handling the tubes to prevent the chemical action of the antiseptic upon glove or hand.

As a general proposition, it may be said that operations in private houses are less liable to be complicated with wound infection, and that the results obtained in operating under these conditions are uniformly good, though the technic of the surgeon is somewhat hampered by the inflexibility of the operating table and by the fact that the source of light is not as readily made as serviceable as obtains in hospital practice.

On the whole, a surgeon supplied with a portable table, and whose assistants exercise reasonable care in the technic of achieving cleanliness, is in a position to do satisfactory work in patients' homes.

CHAPTER VIII

DRAINAGE OF OPERATIVE WOUNDS

Drainage in uninfected cases—Drainage in infected cases—Drainage agents: —Tube drainage; silk-worm gut drainage; catgut drainage; rubber tissue drainage; textile fabric drainage.

The drainage of operation wounds, the question of its introduction, its maintenance, and the length of time agents introduced for the purpose of drainage should remain *in situ* are important factors in the treatment of wounds, the outcome of surgical procedure.

It may be said, in a general way, that drainage of operation wounds is not as universally employed at this time as has obtained in the past. A clearer understanding of the processes of repair of surgical trauma and the part taken by secretions, the result of reparative process, and a better knowledge of the ability on part of the body to take care of certain exudates are responsible for this.

Yet it is to be understood that drainage has a clear and definite place in surgical technic, and that, while an unfavorable outcome may result if it is not employed, rarely indeed would its establishment be followed by other than delay in repair of the wound or possibly in the abdomen, by the occurrence of hernia. Certain it is that, if it be doubtful in the mind of the surgeon whether drainage in a given case is to be established or not, it is wisest to employ it. Indeed, in these doubtful cases the subsequent behavior of the case, as determined by the symptomatology, will not infrequently permit of the removal of the drainage agent at a time when the reparative process would have been so little interfered with as to practically preclude the likelihood of hernia or undesirable cosmetic outcome.

In a general way it may be said that infection in the operation field calls for drainage, the absence of infection justifies disregarding it. However, there are situations and conditions where infection is present when drainage is not alone unnecessary, but a prejudice to the best possible ultimate outcome, such as the removal of pyosalpinx by the abdominal route, in which instance the character of pus is such as to render drainage unnecessary, and the presence of a drain extending through the abdominal wall favors the occurrence of ventral hernia, while the irritation of the peritoneum arising from the presence of the drain agent is liable to produce adhesions of the abdominal contents which are undesirable.

Again, if the operation field be extensive, such as obtains in the removal of large neoplasms, and there has been much trauma to the surrounding tissues, the conditions are exceedingly favorable to the development of infection, the outcome of accidental fertilization. Under these conditions it would be best to establish drainage.

It may also be said that the necessity for drainage in uninfected operative cases bears a direct proportion to the thoroughness with which hemorrhage has been arrested. The presence of blood clots in the blind spaces of an extensive wound favors infection, and the forcible manipulation of wounds of dimensions inadequate to the gentle manipulation of the area invaded also markedly favor the development of infection.

If, on the other hand, the complete arrest of all oozing in a wound of extensive dimensions is going to prolong the surgical manipulations, and possibly call for the use of excessively hot solutions or strong astringents in order to arrest it, it would be wisest to introduce drainage in order to permit of the discharge of serum and the expulsion of blood clots early during the process of repair.

The necessity for drainage in a given class of cases is perhaps best taken up in the discussion of the care of operation wounds under the special heads, and, indeed, this will be found done. However, the general principles involved are properly taken up at this time.

DRAINAGE IN UNINFECTED CASES

The theory of drainage in cases where infection does not exist at the time of the operation is to either remove secretions, the outcome of the process of healing, which would prejudice complete and rapid repair, or to provide an avenue of escape for infective material which may have been accidentally introduced during the operation. The exudate consequent upon the process of non-suppurative repair ceases at the end of three times twenty-four hours after the operation, and infection introduced during the operation should manifest itself in modification of the normal expression of metabolism, *i.e.,* temperature and pulse rate, within that time.

What exudate occurs during this period of time may be regarded as physiological if no infection has been introduced. This means that at the end of this time the drainage agent may be removed if there be no indication to the contrary. The drainage, too, will have filled its office in having maintained an avenue of escape for non-infected exudates which might mechanically interfere with union, and therefore it, too, may be removed.

Taking into consideration the longer period of incubation of infective processes, the character of which is of so little virulence as to require a longer period of time than this to develop, and which may be regarded as capable of no greater harm than local manifestations of minor import and the consequent pathologic process, they are readily taken care of with less unfavorable outcome to the ultimate result than would obtain had the drainage been prolonged. Certainly it is warrantable to assume that no particularly dangerous occurrence will manifest itself later than the fourth day after the operation, and the infrequent times when late infection occurs does not justify jeopardizing the chances of a favorable immediate outcome by over-precaution, more so as in the vast majority of cases the practice suggested has been found to be a good one, as the outcome of prolonged experience in cases of this sort.

DRAINAGE IN INFECTED CASES

Drainage in infected cases is most generally necessary. The instances when it may be ignored are rare, though it may be said that infections of organs covered by peritoneum make the exception, *i.e.,* an infected organ which is attacked by the surgeon through its peritoneal covering does not necessarily call for drainage of the entire peritoneal sac.

This exception relates, however, only to instances in which the infective process in the given part is of a character which justifies the belief that the virulence of the infective process has been exhausted as the result of a prolonged combat between the invading infection and the resistance of the part, and the operating is undertaken for the relief of pain and affliction, the outcome of a now quiescent process, or with the view of forestalling occasional exacerbation of the disease and possible excursions into contiguous parts, organs, and tissues.

Again, drainage may be discarded in cases where the infection has not yet markedly involved the peritoneum, and the operation radically removes totally the source of infection. This contention is elastic, however, in the sense that a moderate amount of infection of the peritoneum will recover without drainage for the reason that the causative focus has been removed and that the peritoneum will take care of a certain amount of exudate, provided this be not fluid pus.

Another consideration which influences the decision in this regard is the fact that localized areas of peritoneum are not drained by the introduction of drainage agents unless the area be isolated by adhesions, and if this be not the case, it is a question whether the surgeon is justified in running the risk of contaminating contiguous healthy portions of the peritoneum in an attempt to obtain dependent drainage. However, this is more largely taken up in connection with the after-treatment of abdominal operations.

In the presence of free pus in this situation, or if there be a reasonable assurance that the area of operation has been exposed to infection, drainage should be always employed. It is a firmly established rule in surgery that all drainage should aim to exercise its office at the most dependent portion of the area of operation, and should be so arranged as not to be interfered with as the result of a posture on part of the patient which would render futile the intent.

DRAINAGE AGENTS

TUBE DRAINAGE

Tube drainage is employed in cases where large quantities of fluid pus is to be removed; also in cases of extensive trauma where there is a reasonable inference that from the character of the injury extensive infection is liable to be manifested. It is rarely used in clean operative wounds, even though exudates are likely to occur, in which latter instances other drains are employed.

Glass tubing has been quite abandoned except in cases of tuberculous peritonitis and, perchance, for drainage of empyema.

Rubber tubing has quite displaced all other material. Rubber tubes should be of sufficient caliber to take care of the indications,

Fig. 142.—Glass Jar Containing Rubber Drainage Tubes of Various Sizes, Submerged in Corrosive Sublimate Solution 1 in 1,000.

with a slight excess of size beyond what is expected in a given case. Drainage should not be indiscriminately used, but when employed should be ample for the purpose. The quality of rubber used is important, as sterilization by heat is exceedingly desirable and inferior quality of rubber disorganizes when exposed to great heat.

In hospitals and office practice rubber tubing of various caliber is, after being boiled, kept in glass jars submerged in aqueous solution of bichlorid of mercury 1 in 1,000 (Fig. 142). This practice is not safe, as the removal of a portion of the contents may result in accidental fertilization. Care should be taken to remove the portion of tubing to be used with sterile forceps.

In private practice tubing of the desired caliber is sterilized in a glass container in which, after having been boiled, it is placed, together with a sufficient quantity of water, and again exposed to heat. The container is then sealed, and fertilization during transportation or while stored is impossible. This is the safest method of handling rubber tubes for drainage. However, it is quite proper to convey non-sterile tubing to the scene of operation and boil it with the instrument or separately. This is a thoroughly efficient method provided the tubing be used immediately.

Fig. 143.—Rubber Drainage Tube Fenestrated and Safety Pin Attached.

When using the tube it is cut to the desired length and fenestrated as shown in Fig. 143. When cutting the fenestra a curved scissors should be used to make oval openings. If the tube be bent at an acute angle and triangular pieces be cut out with straight scissors, the resultant fenestrum is diamond-shaped, and the tube is liable to kink at this point and become obliterated when placed *in situ*. In order to prevent the tube from slipping into the cavity it is draining, a safety pin is fastened to its protruding end in the manner shown in Fig. 143. The pin should be pushed through the side of the tube and not cross the caliber of the tubing at its center to avoid obstruction of the flow of discharges.

The protrusion of the tube beyond the skin should be as slight as possible, just sufficient to allow for the safety pin and a pad of gauze underneath the latter. This precaution avoids obliteration of the end of the tube by pressure from the protective dressing (Fig. 144). The object of the gauze pad is to prevent contact of the pin with the wound, which might cause irritation if this precaution were not taken.

Tube drainage being usually employed for the drainage of pus

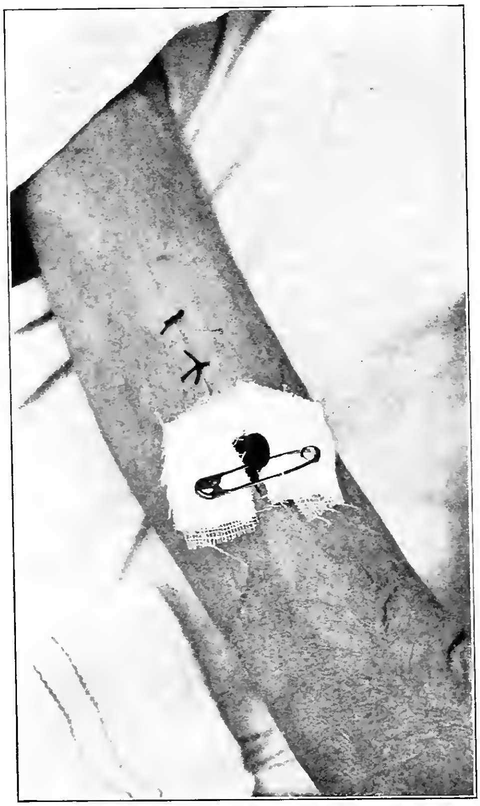


FIG. 144.—RUBBER TUBE DRAINAGE *in situ*.

cavities, the dressing is changed at frequent intervals. This is the more imperative at the expiration of the twenty-four hours following the operation because the trauma resulting from the surgeon's manipulations causes a certain amount of hemorrhage. The oozing of blood into a cavity causes the formation of blood clot, and this is liable to, and, indeed, most usually does, invade the tube, obstructing its lumen. Therefore, the tube should be removed at the end of twenty-four hours, the clot from the lumen and those formed in the cavity expressed, and the tube reinserted. Disregard of this precaution frequently leads to constitutional disturbances, the outcome of absorption of the retained secretions.

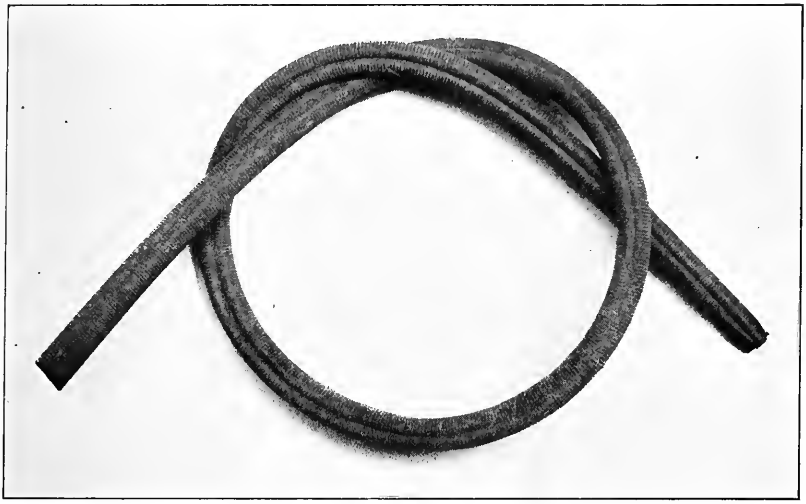


Fig. 145.—Triplex Rubber Drainage Tube.

A so-called triplex drainage tube has recently been employed by the writer with success. The tube is made of pliable rubber (Fig. 145), and consists of three small tubules molded together. The smaller lumen acts slightly like a capillary tube. The arrangement also permits of washing of a cavity through one of the openings, while the other two furnish ample avenue of escape of secretions and allow of free escape of the cleansing fluid. Fig. 146 shows a transverse section of the tube.

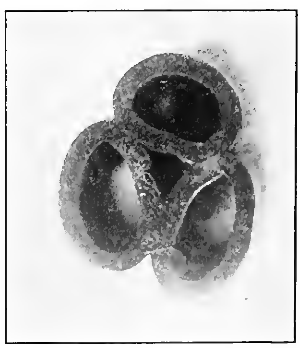


Fig. 146.—Transverse Section of Triplex Rubber Drainage Tube.

SILK-WORM GUT DRAINAGE

Silk-worm gut is employed for drainage purposes in cases where there has been much oozing, with the view of draining off serum and fluid blood. It is rarely used when infection exists at the time of the operation, though in the event of a small abscess cavity being present, it may be used in place of tube drainage. It is often employed in cases of removal of tuberculous glands which have no surrounding mixed infection, and the operator feels that drainage for a few days is a wise precautionary measure.

For the purpose several strands of silk-worm gut are used, the number employed depending upon the area requiring the measure, which are looped in the manner shown in Fig. 147. The loop spreads out the underlying cavity, and by capillarity the fluid exudate is caused to emerge at the twisted ends. In cases of moderate infection a strand at a time may be removed from the wound as the discharge becomes less, thus maintaining drainage in proportion to the indications. Fig. 148 shows the silk-worm gut drain placed *in situ*.

FIG. 147. — SILK-WORM GUT LOOPED FOR DRAINAGE PURPOSES.

CATGUT DRAINAGE

Catgut drainage is employed in much the same way as is silk-worm gut. It is, however, never used in the presence of purulent infection. It has the presumable advantage of being absorbed and need not be removed. In a clean case its employment assures an avenue of escape for the fluid exudates, and the fact that it is absorbed prevents the necessity of disturbing the dressings in order to remove it. It is also employed in operations upon bones following which absolute immobilization is desirable, and is exceedingly serviceable when complete rest of the part is regarded as essential. On the whole, it may be regarded as having an exceedingly restricted field of usefulness. Fig. 149 shows the arrangement of the catgut for the purpose.

It is wiser to use a large number of strands of fine catgut than a few heavy ones, for the reason that offensive exudates are more thoroughly removed by having the way of egress indicated in multiplicity, and the circulating fluid is more apt to act quickly

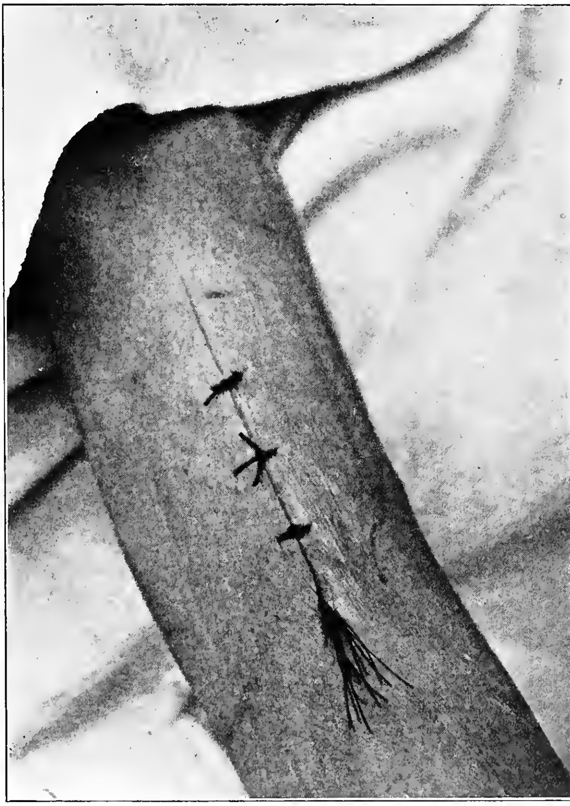


FIG. 148.—SILK-WORM GUT DRAIN *in situ*.

if the surface exposed to absorption is large. Fig. 150 shows catgut drain *in situ*.

RUBBER TISSUE DRAINAGE

Rubber tissue for drainage is employed in much the same class of cases as silk-worm gut and tube drainage, except that it should be used to drain cavities of moderate dimensions. The rubber tissue is prepared by boiling and is stored in a flat glass dish submerged in sterile saline solution (Fig. 151).

For the purpose of drainage the tissue is cut to the desired size and rolled upon itself into a tubular form (Fig. 152). Silkworm gut, catgut, and rubber tissue drains are not cut at the level of the skin, but are, because dependent upon capillarity for action, permitted to protrude to a considerable extent from the wound.

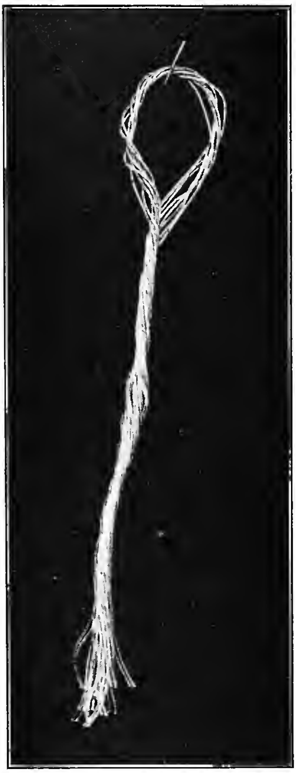


Fig. 149.—Catgut Arranged for Drainage.

All of these agents act better when the portion of protective dressing with which they are in immediate contact is moistened with sterile water, as capillarity is more effective when it need not overcome the resistance of non-saturated surroundings. The rationale of this is illustrated by the housewife who moistens a new lamp-wick at the burner before she attempts to ignite it. Rubber tissue drains have the advantage of not forming attachment to the tissues, and thus interference with action is not likely to occur. Also, when they are removed, the edges of the wound are not disturbed, and the patient is saved pain and annoyance. Fig. 153 shows rubber tissue drain *in situ*.

TEXTILE FABRIC DRAINAGE

Various forms of medicated gauze are used for the purpose. Their action is similar to that of the preceding. As a general rule, it may be said that drains which act by capillarity should take the place of tube drainage when dependent drainage cannot be obtained. Tubes will not drain "up hill"; capillary drains, while not as effective when draining upward, still will act when not placed in dependent positions. Textile fabric presents the best mechanical agent to accomplish the purpose. However, gauze is not resistant to pressure, becomes adherent to the surrounding tissues, and thus its action is considerably interfered with. To obviate these objections, the so-called "cigarette drain" has come into use.

It consists of gauze rolled to the desired thickness, the diameter depending upon the size of cavity to be drained, and this surrounded with rubber tissue, leaving a portion of gauze at either end uncovered (Fig. 154). This arrangement acts like a wick, the end which is buried in the wound collects the exudates, which are led along the gauze inclosed in the rubber tissue and discharged by means of the distal end into the protective dressing. In this

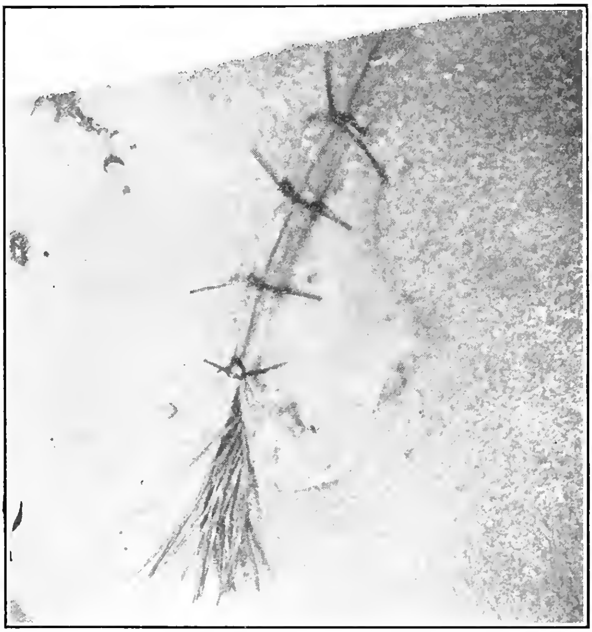


FIG. 150.—CATGUT DRAIN *in situ.*

instance the gauze should be moist, and the two ends especially should be quite soaked with salt solution or, in certain cases, with antiseptic solution.

This drain is the one most generally used in surgery. It is clean, easily handled, and effective. It may be used in aseptic or infected wounds. In the latter instance, however, it must be changed frequently, as the gauze very soon becomes the *nahrboden* for bacteria. However, the fact that its replacement is attended with so little disturbance makes this fact only slightly objectionable. Fig. 155 shows the "cigarette drain" *in situ.*

The arrangement of silk-worm gut, catgut, rubber tissue, and the cigarette drains is shown in Figs. 148 to 155. The silk-worm gut and catgut drain will be seen to extend to a considerable extent beyond the margins of the wound. This favors capillarity.

The silk-worm gut drain allows of removal of a strand or two

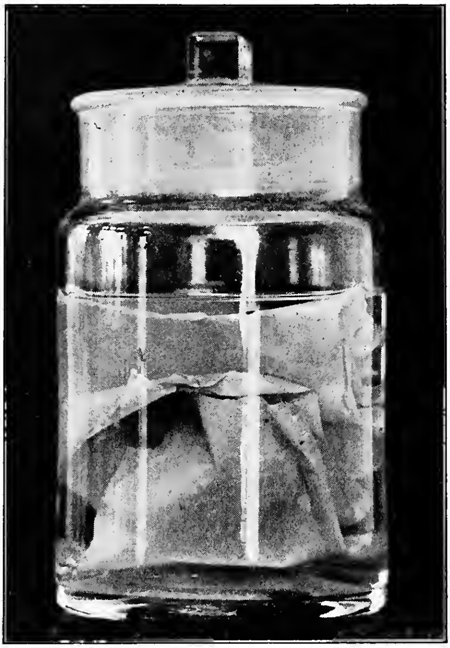


Fig. 151.—Glass Jar for Storing Sterile Rubber Tissue in Corrosive Sublimate Solution 1 in 1,000.

at a time as the discharge from the wound becomes less. The catgut drain, as already stated, need not be removed, being absorbed. However, there is some irregularity with regard to the time re-

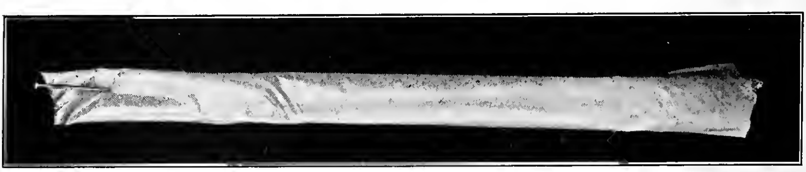


Fig. 152.—Rubber Tissue Rolled on Itself for Drainage Purposes.

quired for absorption of this agent, and at times these drains also require removal.

The cigarette drain should protrude slightly from the wound, the gauze being, of course, made to extend beyond the rubber tissue envelop. The rubber tissue drain protrudes to the extent shown.

Rubber tissue drains do not act by capillarity and simply provide an avenue of egress for the discharges. Logically, rubber tissue drains should be employed only at dependent portions of the wound.

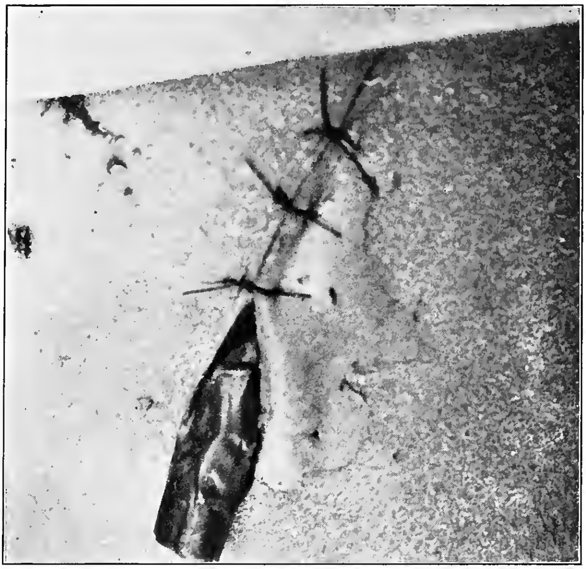


Fig. 153.—Rubber Tissue Drain *in situ*.

Their most useful field is that of drainage of uninfected wounds where much trauma has been necessary. They occupy a position,

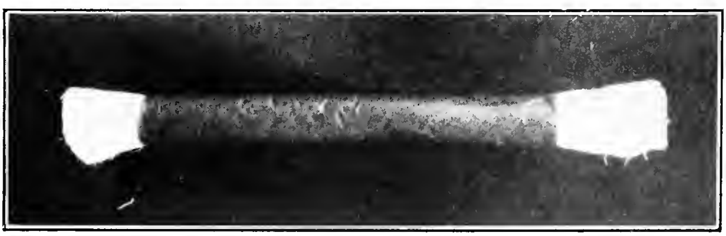


Fig. 154.—Cigarette Drain.

as regards efficiency, about between cigarette drains and silk-worm gut drains.

The indication for their use may be illustrated as follows. Given a celiotomy for infection in the female pelvis with many adhesions and considerable trauma to the abdominal wound, the outcome of severe manipulations during the operation, it not uncommonly occurs that the sheath of the rectus sloughs. In this instance rubber tissue drainage under the skin is a wise measure. Given, on the other hand, a case of neoplasm of the neck which requires much dissection without any particular mauling of the tissues, the employment of silk-worm gut drainage for a few days subsequent to the operation is sufficient to meet the indications.

Rubber tube drainage, except in rare instances such as em-

FIG. 155.—CIGARETTE DRAIN *in situ*.

pyema, or suppurative osteomyelitis, need not be maintained for more than three or four days. It may then be replaced by rubber tissue drainage, and ultimately by a silk-worm gut drain, and this removed strand by strand as indicated by the amount and character of the discharge from the wound. Prolonged maintenance of drainage is prejudicial to repair, and in no instance should drainage agents be caused to make undue pressure on the tissues.

CHAPTER IX

SUTURING OF OPERATIVE WOUNDS

Needles—Needle holders—Suturing of wounds: The continuous suture; the interrupted suture; harelip pins.

The object of suturing wounds is to hold tissues in apposition until repair takes place. Forcible apposition of wound surfaces attains no desirable object, and is objectionable for the reason that normal interchange of nutritive elements is interfered with, caus-

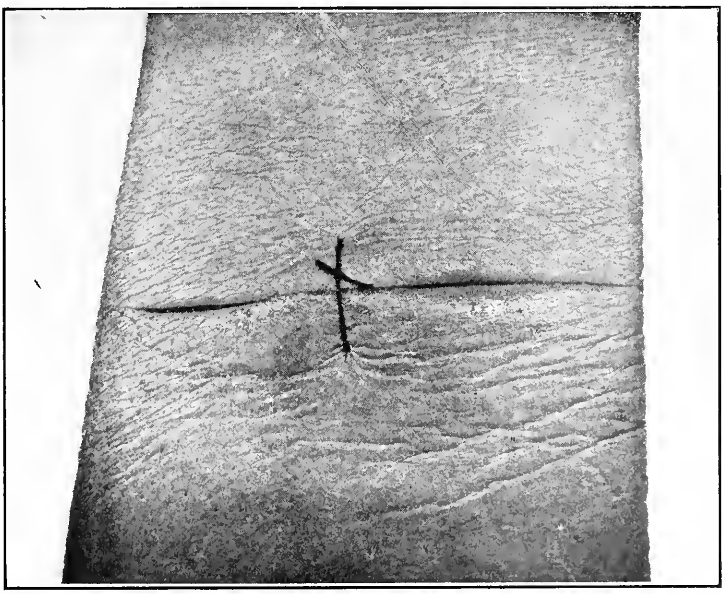


FIG. 156.—SUTURE PROPERLY TIED. Knot drawn to one side.

ing pressure necrosis, and unnecessary deformation of needle punctures is provoked, resulting in unsightly scaring. Wounds subjected to pressure from sutures are liable to infection for the reasons stated.

A properly introduced suture causes the edges of the wound to lie in gentle contact with each other (Fig. 156). A skin suture should not produce wrinkling within its confines. As a general rule, a suture which wrinkles the skin is too tightly drawn (Fig. 157). It may be said that wounds should be held in appo-

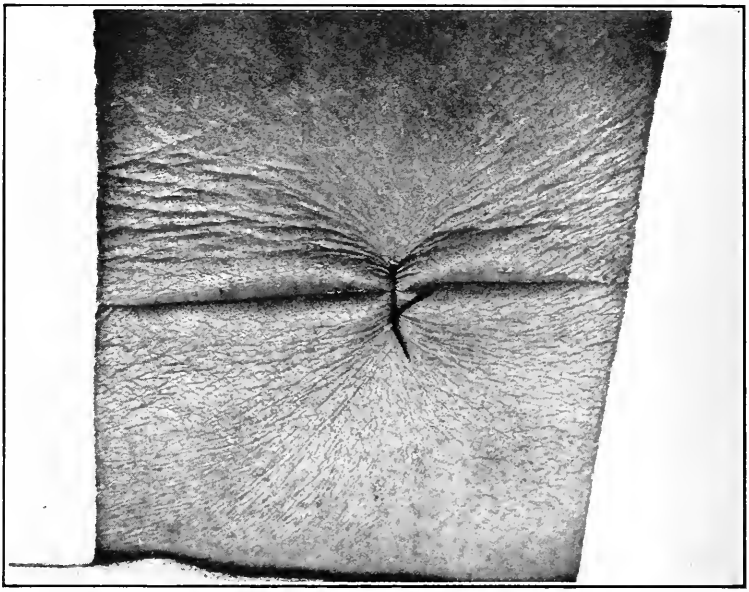


FIG. 157.—SUTURE IMPROPERLY TIED, CAUSING STRANGULATION OF THE TISSUES.

sition without tension. If approximation without tension is not feasible, relaxation sutures should be introduced to obviate the tension of the tissues immediately contiguous to the wound. (Figs. 179, 180, 181, 182.)

When sutures are introduced in the faulty manner shown in Fig. 157, the skin is puckered, the outer surface of the skin is brought in contact, and union of the edges of the wound does not take place. In another class of cases the skin is turned outward with the same result. In either instance the surgeon is confronted with a failure of accurate healing, and the ultimate outcome is a faulty cosmetic result. This may not be a matter of great import in instances when the operation involves the unexposed portions of the body, but is of great significance when the face is attacked.

In any event it means somewhat protracted healing, which is unnecessary and should be avoided.

NEEDLES

The suturing of wounds is accomplished by means of needles of various kinds. Much has been written with regard to the employment of various kinds of needles in the several parts, organs, and tissues of the body. An extended consideration of the relative value of the several kinds of needles to be used in given parts does not properly belong here. It is, however, proper to state, in a general way, that needles which puncture the tissues are best used in the skin and superficial parts, while needles which separate the tissues are of most service in apposing muscles and serous membranes.

The diameter of the needle to be used for a certain repair depends upon the thickness of the suture it is intended to carry through the tissues, and the latter depends upon the amount of tension to be overcome and the length of time, immobilization, and apposition of the divided parts is to be maintained.

Needles intended to puncture the tissues are usually made

Fig. 158.—Straight Surgical Needle with Cutting Edges. (*Bryant.*)

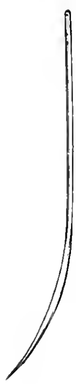


Fig. 159.—Half-Curved Surgical Needle with Cutting Edges. (*Bryant.*)

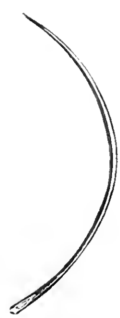


Fig. 160.—Full-Curved Surgical Needle, with Cutting Edges. (*Bryant.*)

with cutting edges, and these are made either straight (Fig. 158), half curved (Fig. 159), or full curved (Fig. 160). In suturing skin where cosmetic effect is to be considered, the flat *Hagedorn* needle is universally employed. These needles are readily obtained in varying forms from the straight variety (Fig. 161), the half curved (Fig. 162), and the full curved (Fig. 163).

FIG. 161.—STRAIGHT *Hagedorn* NEEDLE. (*Bryant.*)

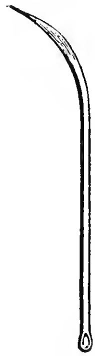


FIG. 162.—HALF-CURVED *Hagedorn* NEEDLE. (*Bryant.*)

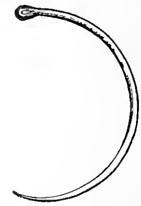


FIG. 163.—FULL-CURVED *Hagedorn* NEEDLE. (*Bryant.*)

The puncture made by the surgical needle causes trauma, as shown in Fig. 164 c, d, *i.e.,* the stitch hole is horizontal to the wound, as would be expected from the nature of the needle, which cuts its way through the tissues, as indicated in Fig. 164, d. When the suture is tied, the conformation of the stitch hole is as indicated in the same illustration. When ultimate repair takes place the residual scar is likely to be offensively manifest. When the *Hagedorn* needle of either conformation is used the stitch hole corresponds to the illustration shown (Fig. 164, b). When, now, the suture is tied, there is a slight elongation of this hole without as great a degree of solution of continuity of tissue (Fig. 164, a). This would argue for the use of the *Hagedorn* needle in all situations in which cosmetic effect is a factor.

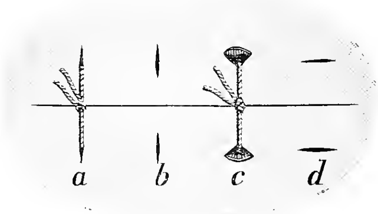


FIG. 164.—NEEDLE WOUNDS. (*Bryant.*)

The round needle employed for approximation of peritoneal surfaces may also be obtained in varying sizes and of varying degrees of curvature, from the ordinary cambric needle to the heavy, curved kind used for repair of the broad ligament (Fig. 165). Beyond this, many forms and kinds of needles are obtainable, an extended list of which will be found in the catalogues of all instrument manufacturers. The general rule here offered is well borne in mind, however, and may be regarded as a guide in selecting an assortment of needles intended to meet the requirements of operations on various parts of the body.

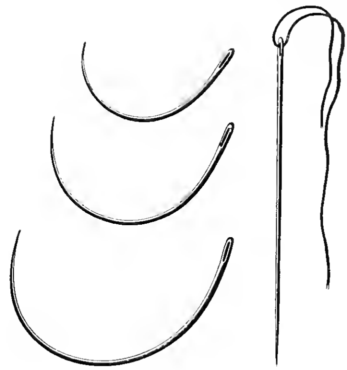


Fig. 165.—Round Needle for Approximating Serous Surfaces and Muscular Fiber. On the right, cambric needle for intestinal suture. (*Kelly.*)

When sutures are to be deeply placed a long needle with a handle is frequently employed. Of this instrument many kinds are upon the market. They possess the advantage of puncturing the tissues deeply and accurately. A few of the sort most commonly used are shown in Figs. 166-168.

Fig. 166 shows the *Coe* needle, which is largely employed to insert interrupted sutures into the abdominal wall following celi-

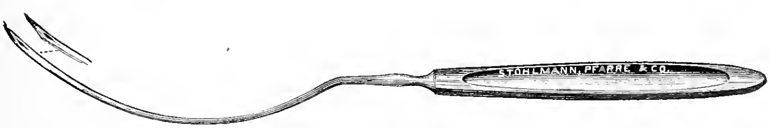


Fig. 166.—*Coe's* Needle with Handle.

otomy. The needle is first introduced and the suture threaded with the eye protruding distally. The suture is then drawn through the tissues in the reverse direction. The difficulty in

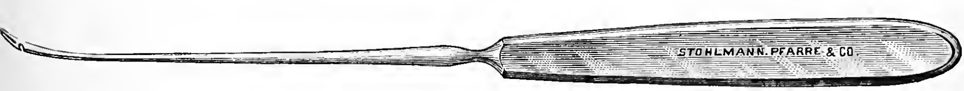


Fig. 167.—*Hagedorn* Needle with *Gentile* Handle.

threading the suture through the eye, which is of course filled with blood, makes this needle less useful than if such were not the case. In instances in which the abdomen is very fat the instrument will be found of service.

Fig. 167 shows a needle devised to overcome the difficulty with respect to threading the suture mentioned, by notching the side of the instrument near its cutting end. This renders insertion of the suture more easy. However, not infrequently the skin is caught in the notch and considerable difficulty is experienced in placing the suture.

Fig. 168 shows a needle used for placing sutures in operations for the relief of hernia. The needle is bent at right angles to the shaft and is furnished with a roomy eye for the purpose of carrying

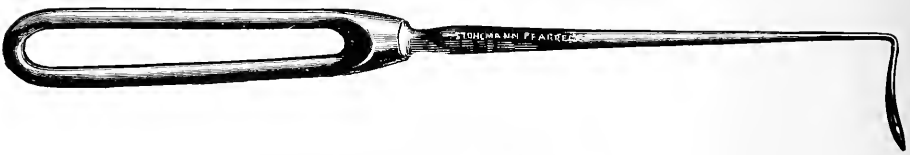


FIG. 168.—*De Garmo's* FEMORAL NEEDLE.

kangaroo tendon sutures, which are largely used for the purpose. The same objection with respect to the difficulties in threading the sutures mentioned is applicable in this connection. It has, however, a useful place in the class of cases for which it is intended.

These nêedles are commonly used in placing relaxation sutures and in suturing the skin of the abdominal wall and after extirpation of the mammary gland in patients who have a large quantity of subcutaneous fat. However, they do not form an essential acquisition to the surgeon's armatarium and may be properly regarded as refinements, and, after all, are of questionable utility. As a general rule, it may be stated that each puncture of the skin increases the liability of infection, and as the needles with a handle must of necessity first transfix the skin and then draw the suture through in the opposite direction, a single manipulation as obtains with the threaded needle is the more desirable manipulation. Indeed, when introducing the interrupted suture, the writer employs several needles in repairing an extensive wound, on the theory that the repeated entrance of the skin with the one needle is more likely to result in skin infection than if a fresh needle be used after several sutures have been placed *in situ*. More especially is this the case in repair of the intestine, where each suture is introduced with a different needle, with the view of forestalling the conveyance of infection by means of a needle and suture which may inadvertently have punctured the lumen of the gut.

NEEDLE HOLDERS

Needle holders are universally employed for the introduction of sutures. Here again an extended discussion is out of place. However, it may be said that the instrument should be used for the purpose in place of the fingers whenever practicable. Instruments are always less liable to be the habitat of infective bacteria than the fingers for obvious reasons, and the manipulations necessary to the introduction of sutures, coming as they do at the end of an operation, find the fingers of the operator frequently contaminated as the outcome of the operative procedure. Indeed, it is the habit of the writer to turn the closure of the wound over to an assistant whenever this is a consideration worthy of being taken into account from the nature of the operation.

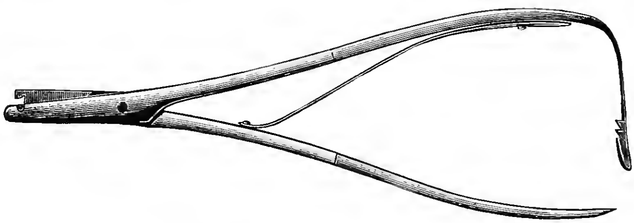


FIG. 169.—*Hartley-Markoe* NEEDLE HOLDER. (*Bryant.*)

As in the case of needles and suture carriers, innumerable models of needle holders are obtainable in the market, each one of which bears a name of an inventor. As a general proposition, the life of utility of a needle holder depends upon the resistance of its biting surfaces. As this depends upon the elasticity of the metal surface, no needle holder will be found serviceable in perpetuity. It is, therefore, well for the surgeon to have within easy reach two needle holders at all times, as the limit of elasticity of the metal may be reached at any time. The disregard of this precaution is often responsible for a display of irritability on part of the operator which, being enhanced by the exhausting effects of a prolonged operation, at times culminates in the offending in-

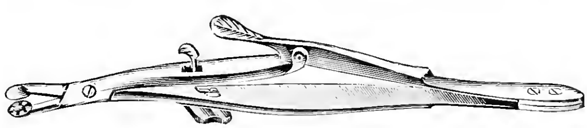


FIG. 170.—*Sand's* NEEDLE HOLDER. (*Bryant.*)

strument being thrown violently upon the floor, and if there be no second instrument at hand, the rest of the suturing must be accomplished with the fingers. This being an undignified and unde-

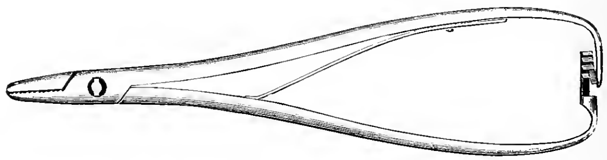


FIG. 171.—*Luer's* NEEDLE HOLDER. (*Bryant.*)

sirable outcome, the precaution mentioned is best borne in mind.

A number of needle holders are depicted in Figs. 169 to 173. Each has its advocates, but, no doubt, acquaintance with the mechanism of any of them will develop efficiency in its use.

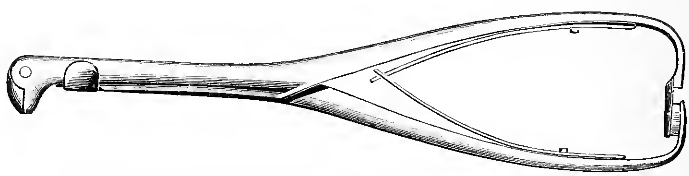


FIG. 172.—*Halsted-Leur* NEEDLE HOLDER. (*Bryant.*)

Fig. 173 shows a holder furnished at its biting surface with a piece of soft metal which will conform to the size of most any needle. It is to

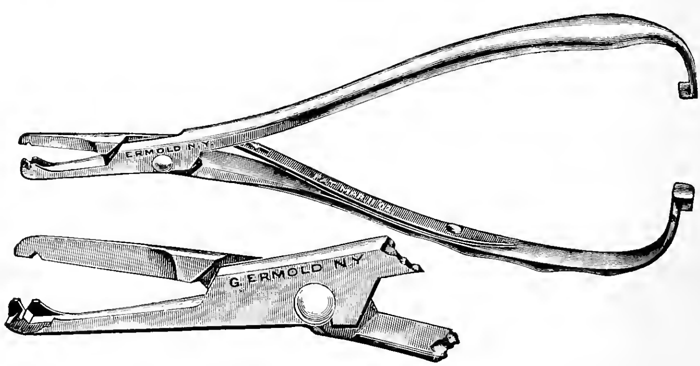


FIG. 173.—ERMOLD NEEDLE HOLDER.

be remembered that this piece of metal ultimately undergoes permanent deformation for the reason already stated, and that this should be frequently replaced. In addition, the lock at the termination of the handles closes at one bite and releases at the next, which makes this an exceedingly comfortable instrument to work with, especially when working in deep cavities.

Fig. 174 shows a needle holder which *Kelly* uses to hold curved

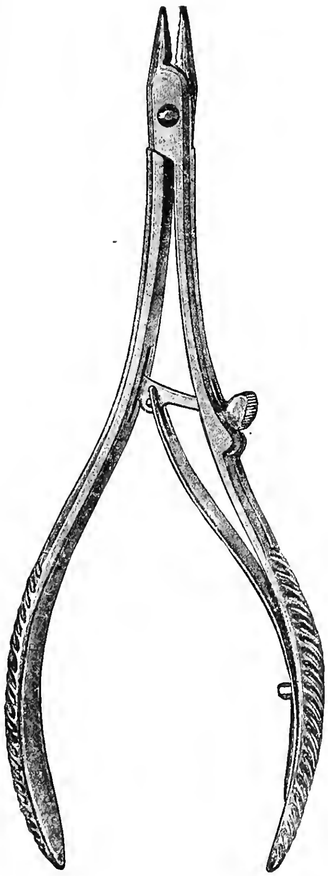


Fig. 174.—*Kelly* Needle Holder for Round Needles. (*Kelly.*)

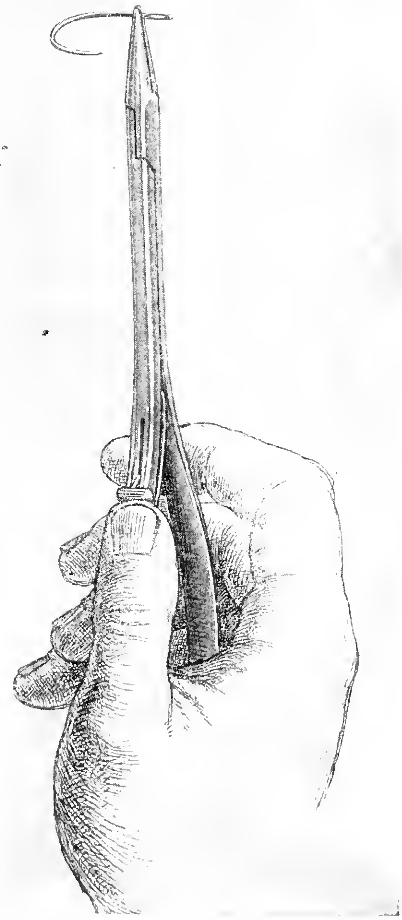


Fig. 175.—Needle Holder Showing Method of Grasping Round Needle. (*Kelly.*)

needles. The handles are heavy and serrated, permitting of a firm grasp, and the ends tapering, which permits of working in deep cavities. The biting surfaces are of soft copper, allowing of adaptability with respect to the size of needle employed. The criticism made in connection with the *Ermold* needle holder respecting permanent deformation of the soft metal applies here. The lock is operated with the thumb and is a convenient one. It is not, however, as readily handled as obtains with the *Ermold* holder.

Fig. 175 shows the manner of grasping the needle near its eye. At this point the needle is usually of greatest strength and is less

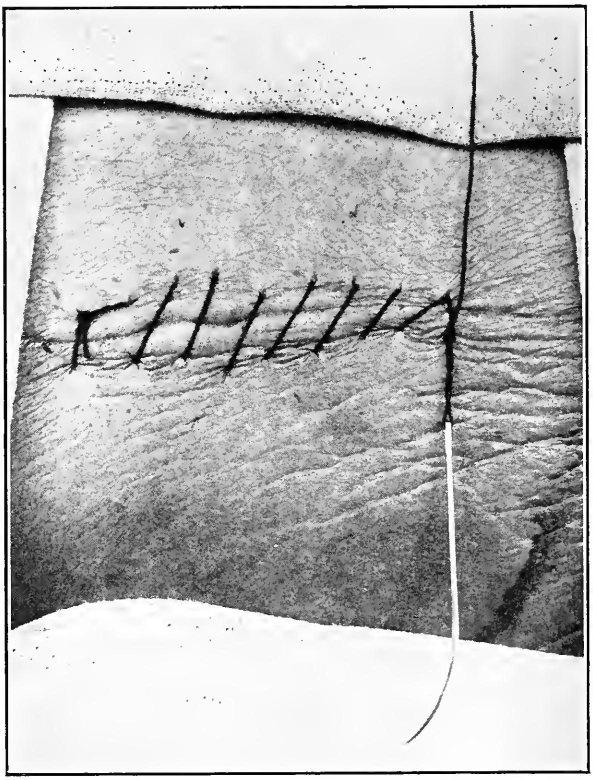


Fig. 176.—Continuous Suture Ready to be Tied. Half-curved surgical needle.

liable to break when being manipulated. On the other hand, the long lever distal to the bite makes this manner of holding the needle less firm when being inserted into resisting tissue, in consequence of which the needle rotates in the holder, giving it a direction in passing through the tissues, other than was intended. This may be overcome by grasping the needle nearer its middle when using it under the conditions mentioned.

SUTURING OF WOUNDS

THE CONTINUOUS SUTURE

The continuous suture is the one most universally used (Fig. 177). When there is reasonable assurance that infection has not

Fig. 177.—Continuous Suture Completed and Tied.

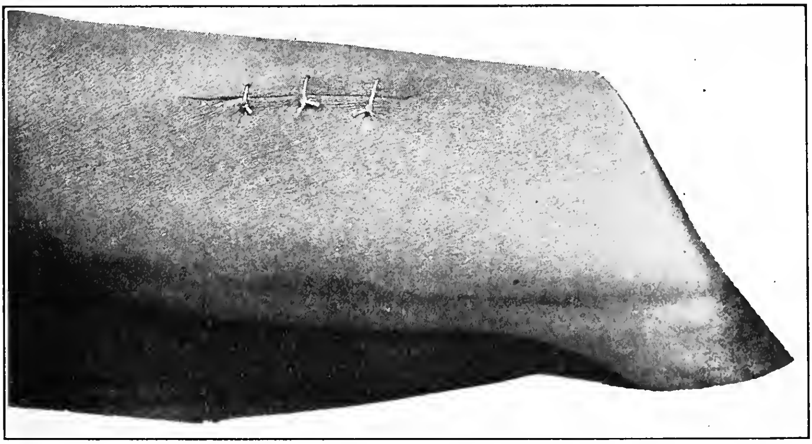


Fig. 178.—Interrupted Suture Properly Introduced and Tied. Knots drawn to one side.

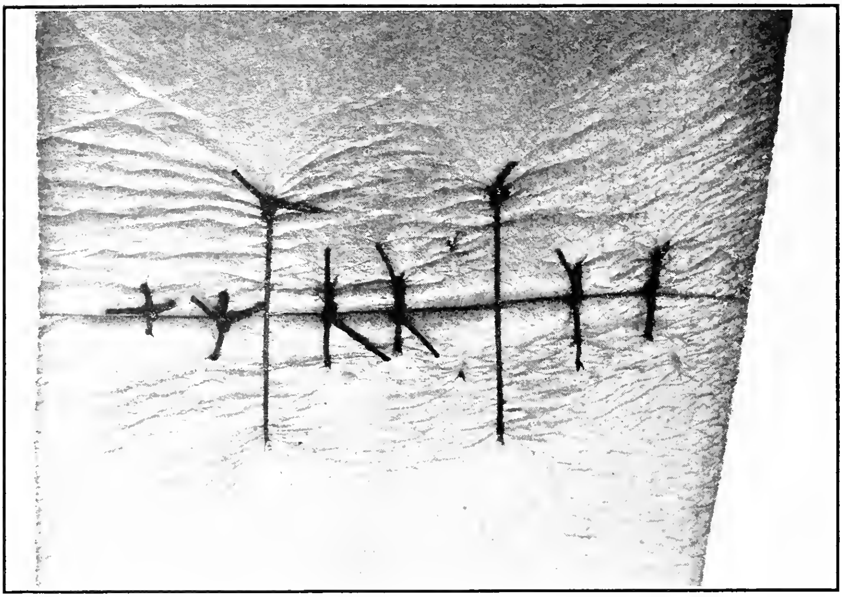


FIG. 179.—RELAXATION OR TENSION SUTURES. The approximation sutures are improperly tied. The knots should be drawn to one side.

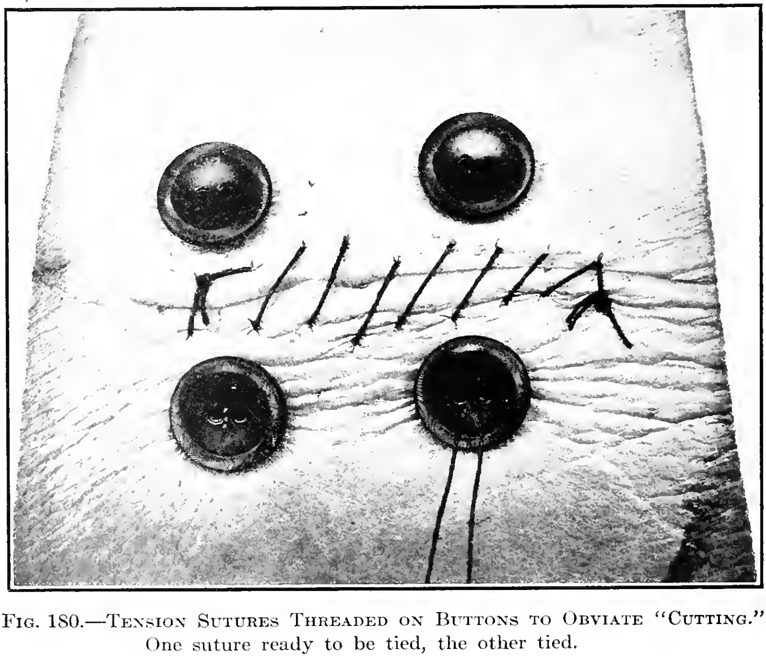


FIG. 180.—TENSION SUTURES THREADED ON BUTTONS TO OBVIATE "CUTTING." One suture ready to be tied, the other tied.

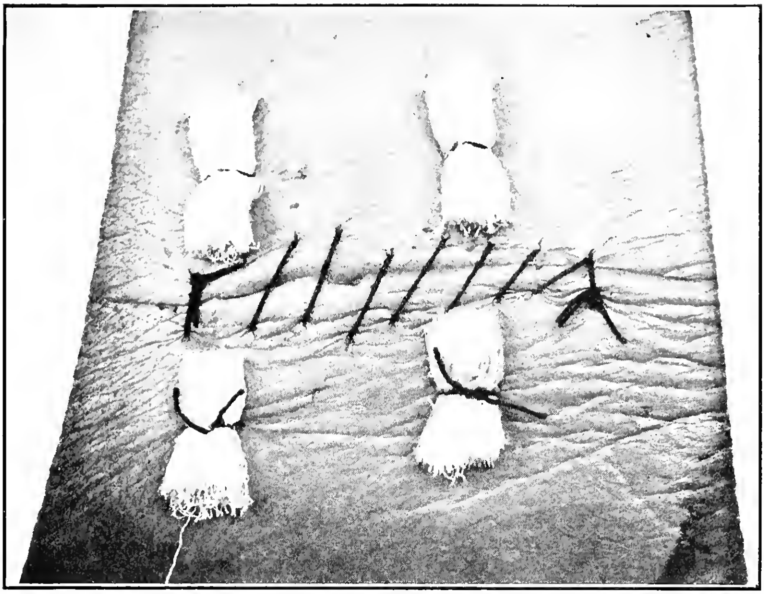


FIG. 181.—TENSION SUTURES LOOPED OVER PLEDGETS OF GAUZE.

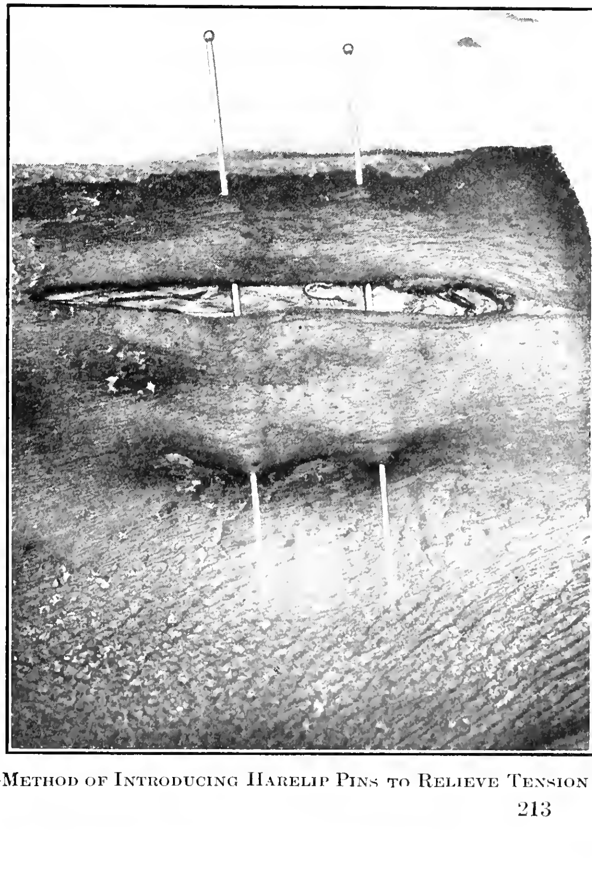


FIG. 182.—METHOD OF INTRODUCING HARELIP PINS TO RELIEVE TENSION IN WOUND.

occurred during the operation, it is a most desirable form of suture, as it permits of accurate apposition of the edges of the wound, and if it be necessary to remove it, the patient is subjected to a minimum of annoyance in accomplishment of the act, as it needs be only loosened at its distal ends and withdrawn. This, of course, applies only when the suture material is of the non-absorbable variety. Fig. 176 shows the continuous suture introduced and

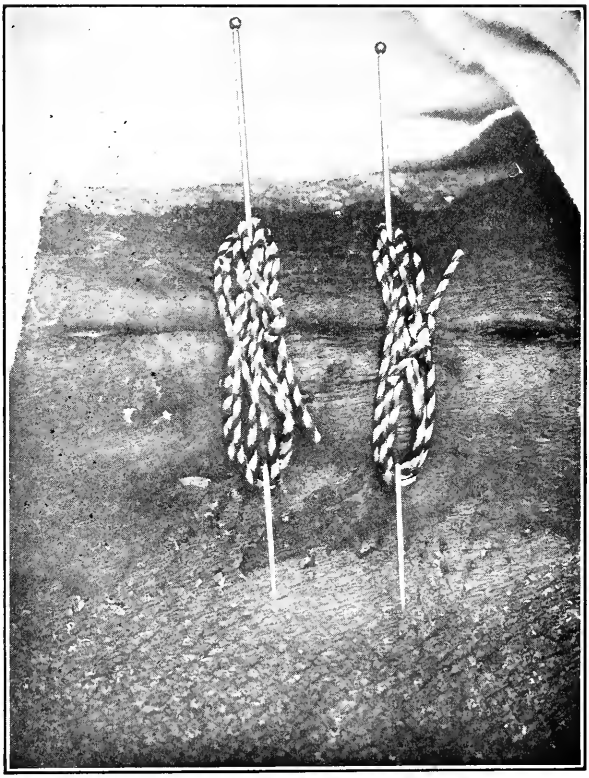


Fig. 183.—Suture Material Looped Over Harelip Pins, Drawing Edges of Wound Together.

ready to be tied. The needle is the one-half curved surgical kind, usually used for the purpose. Fig. 177 shows the suture finished, and the ends cut short.

The usual rule is to employ this class of suture in the deep tissues and not in the skin, for the reason that abscess in the suture punctures is exceedingly liable to happen in the latter situation despite all precautions, and the continuous suture forms a path along which infection may easily travel. In the illustrations the suture is shown introduced into the skin for the sake of clearness.

THE INTERRUPTED SUTURE

The interrupted suture is shown in Fig. 178. Care should be taken not to draw the edges of the wound too tightly together

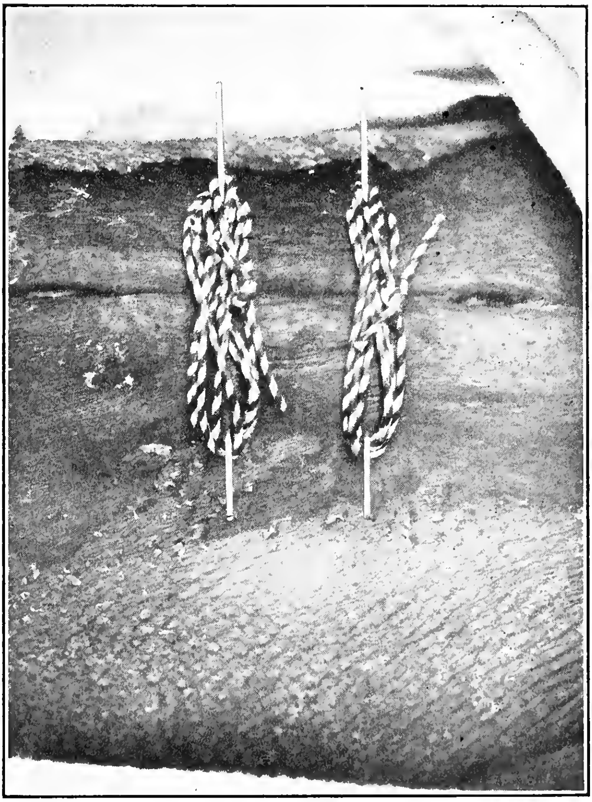


Fig. 184.—Ends of Harelip Pins Cut Off.

(Fig. 157), but to simply bring them into apposition (Fig. 156), for the reasons already stated. If there be much tension in the wound, relaxation sutures are introduced. These may consist of simple deep sutures introduced in the manner shown in Fig. 179, or threaded on buttons (Fig. 180), or looped over pledgets of gauze

(Fig. 181), with the view of obviating undue pressure on the tissues.

HARELIP PINS

Some surgeons prefer to supplement the approximation sutures with the introduction of harelip pins. These pins are introduced quite widely from the edges of the wound (Fig. 182), and heavy suture material is looped over the protruding ends (Fig. 183), bringing the edges of the wound together. The ends of the pins are at last cut off as in the manner shown in Fig 184.

Harelip pins are likely to cut into the soft tissues, especially if there be much tension, the outcome of the effort to approximate the edges of the wound. This makes the employment of the pins less serviceable than the button suture or the loops padded with gauze pledgets.

CHAPTER X

THE DRESSING OF OPERATIVE WOUNDS

Antiseptic powders—Iodoform and its modifications—Application of powder—The protective dressing—Gauze for dressings: Medicated gauze; sterile gauze; the combined dressing.

ANTISEPTIC POWDERS

After approximation of the edges of the wound, it is customary to apply to it and the surrounding surfaces some antiseptic powder. This is, however, not so universally done at this time as obtained formerly. The use of certain agents seems to go in cycles. At times an agent which has been quite universally employed by every one falls into disuse, to be, perhaps, again exploited and to have as wide a vogue as ever.

The fact is, that the use of antiseptic dusting powders has a rationale which has its justification in chemistry and bacteriology as applied to their employment in this connection. Before the employment of asepsis, dusting powders and certain remedial agents were applied to wounds with the idea of stimulating repair. A more accurate knowledge of the genesis of cells following surgical trauma has shown that the real usefulness of antiseptics lies in their power to destroy bacteria, although no one could deny that the application of a sterile mercury ointment to a wound in the person of a syphilitic who has been subjected to operation has a beneficial effect, and that the introduction of iodoform into the superficial wound of approach in removal of tuberculous glands is a scientific and rational indulgence. Then, too, if there be infection in the operative field, it is more reasonable to expect benefit from antiseptic lavage than from mechanical cleansing, especially with saline solution. For if there is a medium which makes a favorable culture field for bacteria, it is a normal salt solution. This is well illustrated by the fact that salt solution is used where tissues are to be guarded against interference with nutrition, such as in skin grafting.

Two factors enter into the immediate after-treatment of operative wounds. One is the prevention of contact of infective material with the wound, and the other the destruction of bacteria which may be in immediate contact with the wound and which will cause infection if the conditions are favorable.

It is, as already shown, quite impossible to sterilize the skin absolutely. Taking the problem up from that standpoint, nothing could be more favorable to the invasion of the wound by infective bacteria than to have it and the contiguous skin covered with a thin layer of serum and coagulated blood. Oozing is never so absolutely arrested as to prevent this contingency. Even though primary union is obtained in a given instance, the skin near the wound and the area of union is always found covered with this coating when the dressing is removed. The fact that serum is so largely used as a culture medium in the bacteriological laboratories would suggest that the statement just made had some foundation in fact.

Assuming that the hair follicles, sebaceous glands, and sudoriparous glands are the habitat of bacteria and that the skin immediately contiguous to the wound is coated with a culture medium favorable to their growth and development, it is easy to see how infection would find its way to the wound, and, indeed, the much discussed stitch abscess may be attributed in a certain number of instances to this cause. It is, of course, not to be forgotten that division of the hair follicles by the puncturing needle is an important causative factor in this connection, yet the one mentioned should not be disregarded.

Indeed, the growth of bacteria always requires a favorable culture medium. It is the experience of all surgeons that stitch abscess does not occur as frequently when silk-worm gut is used in approximating the wound as when catgut is employed for the purpose. This does not by any means permit of the conclusion that the catgut was not sterile. It may simply mean that catgut is a far more favorable culture medium for bacteria than is the smooth, hard silk-worm gut. The fact that catgut undergoes a physical change while *in situ* may, too, contribute to this difference, *i.e.*, the gradual absorption of the catgut probably changes it into a more favorable culture medium for bacteria, an assumption supported by the fact that infection in the stitch holes occurs not infrequently on the eighth, and even as late as the twentieth day.

Assuming a wound approximated by a continuous catgut suture, the line of which, together with the immediately contiguous skin, is coated with a layer of wound secretion, no great stretch of the imagination is required to see a colony of bacteria invading the crust, either from a neighboring hair follicle or from one of the perforations made by the needle, growing rapidly, and extending along the entire suture line. These are conditions exceedingly favorable to infection of the superficial wound and, indeed, the outcome is of sufficient frequency to be a familiar picture to the surgeon, and more especially to the practitioner who carries out the after-treatment and is, at the end of a week, confronted with a state of affairs for which he is not infrequently made responsible by the patient and, too, greeted at times with certain sarcastic remarks from the operator.

In contrast to this, it is also easy to see that, given a wound closed by interrupted sutures of silk-worm gut, the edges and surrounding skin of which is covered with an antiseptic which impregnates the secretions, infection is not so liable to occur. And, indeed, this is quite the fact. At times an infection of a single stitch will occur, and be it said that this may be the case despite all precautions. However, infection of the entire wound is certainly less apt to obtain if the latter conditions prevail.

IODOFORM AND ITS MODIFICATIONS

An effort has been made to obviate contamination of the wound by sealing it firmly with collodion. This has proven unsatisfactory, however, as it retains the secretions from the wound in a confined place, does not destroy the bacteria in the stitch holes, and infection occurs. The general surgical principle of the confining of secretions applies here with equal force, though the quantity of secretion is very small. If, however, the collodion be thoroughly impregnated with an antiseptic, the bacteria may be destroyed. It is, nevertheless, a better principle to permit bacteria to exhaust themselves in a large antiseptic area than to depend upon the bactericidal effect of small quantities of antiseptics.

Iodoform has maintained its place in this field of usefulness. It has been shown to be of itself less resistant to the invasion of bacteria than is suggested by its manifestly beneficial effect clinically demonstrated. It is probable that the combination of the agent with blood liberates free iodin upon which its usefulness depends. The objectionable odor of iodoform has led to many modifications in its preparation, of which aristol is an example. It is probable that aristol is quite as efficacious as the former, and is free from odor. Iodol, naphthalin, and similar preparations are largely used for the purpose, all of which have exponents. Orthoform, vioform, bismuth and the like are all of usefulness. Vioform is largely used in Berlin.

APPLICATION OF POWDER

Care should be taken to sterilize the agent before use, provided heat will not cause a chemical change rendering it inert. In any case the container should be sterilized before the operation. Ordinarily the powder is applied to the wound and surrounding parts with a sprinkler (Fig. 185). This apparatus is exceedingly convenient and cleanly if sterilized each time it is used. Repeated use of the sprinkler without this precaution is warned against.

Fig. 185. — Antiseptic Powder Sprinkler. *(Bryant.)*

A safe and convenient method of use is to place the powder into a sterile jar, covered with wide-meshed gauze. The powder may then be applied without fear of causing contamination. About enough powder for an operation may be prepared from the stock package for each operation, and the small quantity remaining may be discarded. Fig. 186 shows a jar prepared in this way. The mixture of blood, serum, and antiseptic powder certainly presents a medium less favorable to the growth of bacteria than do the secretions alone.

Before applying the powder, the wound is washed with a solution of corrosive sublimate 1-1,000, and the secretions from the wound together with the solution are wiped away. Covering of the wound with inordinate quantities of powder serves no useful purpose; indeed, in the instance of iodoform, poisoning may occur. Of course this is not likely to be the case if the iodoform be used on a sutured wound, and applies more largely to its application to extensive raw surfaces. However, the possibility of its occurrence is to be remembered. Again, iodoform at times gives rise to dermatitis, and, indeed, some individuals posses an idiosyncrasy in this regard. The condition disappears as soon as the cause is removed. Patients found susceptible in this way should be informed of the conditions with the view of obviating a recurrence of the event.

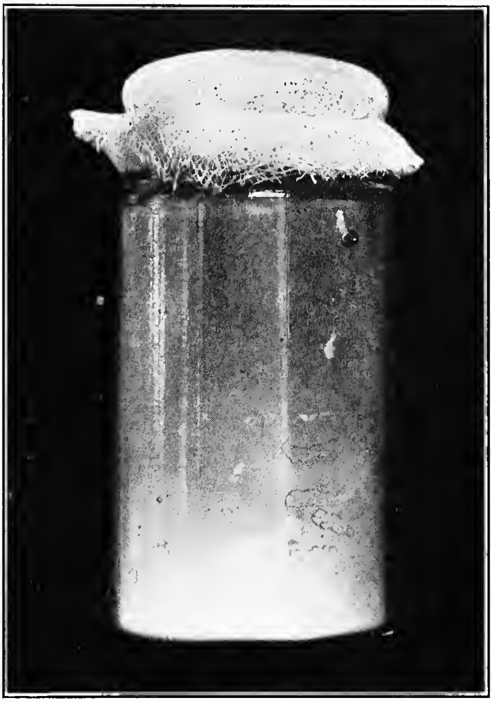


Fig. 186.—Powder Sprinkler Used in Operating Room.

In wounds which are drained, too liberal a use of powder may obstruct drainage, and care should be taken to avoid this. As a general proposition, a moderate use of these agents conserves the interests of the patient better than too liberal application.

THE PROTECTIVE DRESSING

The protective dressing is applied to wounds for the purpose of absorbing discharges and to prevent the entrance of infective agents. The immobilization of parts in order to conserve repair is a problem entirely distinct from the two propositions stated, though, of course, the three objects are attained simultaneously.

If the theory offered with regard to the susceptibility of exudates from wounds being exceedingly favorable to the development of infection be true, there is no question as whether sterile dressing material or material impregnated with antiseptics is the more rational. However, the contact with the skin of material saturated with wet antiseptics is objectionable on the ground that irritation is a frequent result. Indeed, this applies also to dry antiseptic dressing material, for the moisture from the skin, together with the secretions from the wound, cause the dry antiseptic to go into solution. However, there is no doubt that too

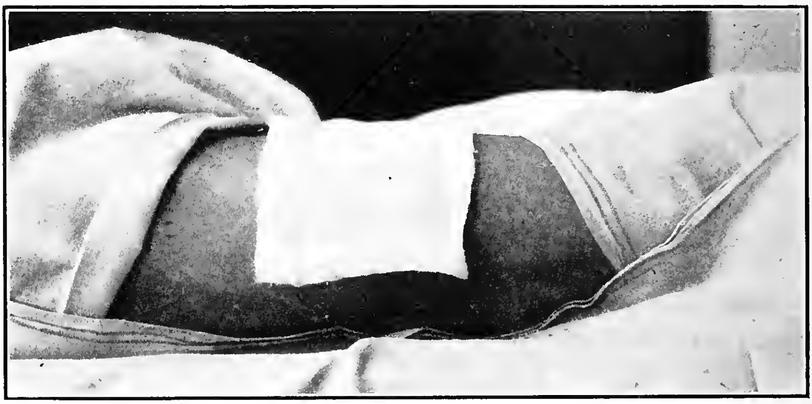


Fig. 187.—Flat Gauze Applied Immediately to Wound.

radical a view of either method is unnecessary, and that the best method of action is found in a judicious application of both principles.

As a general proposition, it may be said that infected wounds should be dressed with a preponderance of antiseptic material over the unmedicated dry material, while clean wounds require less employment of the antiseptic dressings. Taking the invasion of the dressing by bacteria from the skin in one direction (outward), and the assault of infective material from the other (inward), it would seem fair to assume that the point at which these two will meet depends upon the distance necessary to be traveled by each, and the character of the medium they have to penetrate. Copious discharges from wounds which entirely saturate the protective dressing constitute an easy avenue of approach in either direction, for obvious reasons. The mechanical hindrance to the entrance of bacteria is best subserved by cotton.

It would seem rational to place in immediate contact with the wound a layer of dry gauze which is sterilized by heat only. This prevents contact with medicated dressing more externally situated, and obviates the danger of irritation to the skin. This is best applied in several layers folded flat (Fig. 187). The secretions from the wound soon saturate this layer of gauze, and the next layer of gauze may be saturated with an antiseptic and dried with heat. Theoretically, bacteria which may invade this layer should be destroyed by coming in contact with an antiseptic

Fig. 188.—Fluffed Gauze Placed Over Flat Gauze Shown in Fig. 187.

solution of which they themselves form the solvent. However, if the case be already infected this layer may be moist at the time of application, and thus more readily take up the secretions.

GAUZE FOR DRESSINGS

Gauze for dressings consists of cheesecloth of varying number of strands per square inch. The closer the mesh the slower will absorption of fluids take place; on the other hand, obviously, the closer the mesh the more fluid will the gauze take up. As a general rule, gauze with 24 x 32 threads per square inch will be found efficacious for all practical purposes.

This layer of gauze should be applied "fluffed" (Fig. 188).

Thus the irregularities in outline of the part are equalized when the final bandaging is done and a smooth surface is presented. This layer of gauze may be simple sterile gauze as is used by a large number of surgeons. However, the considerations mentioned are worthy of taking into account in determining the question of medicated gauze. The preparation of iodoform gauze has already been described (page 76).

Gauze is prepared by immersing cheesecloth of the desired number of threads to the square inch in cold water for twelve hours, with the view of dissolving the starch. It is then boiled for several hours, dried, and cut into various sizes determined by the purpose for which it is to be employed. It is then sterilized under pressure, as already described (page 62). The impregnation of the gauze, with antiseptics is accomplished by immersing the gauze, after boiling, in a solution containing the desired antiseptic and, after drying again, sterilizing under pressure. The antiseptics most commonly used for the purpose are carbolic acid 1 in 20, corrosive sublimate 1 in 1,000, mercuric cyanid 1 in 1,000, and the iodoform gauze mentioned.

Corrosive sublimate gauze is made as follows:

Strength.	1 in 1,000	1 in 500	1 in 400
Absorbent Cotton (Dry)......	13 oz. (10 yds.)	13 oz. (10 yds.)	13 oz. (10 yds.)
Corrosive Sublimate Sol. 1-1000	12½ oz.	25 oz.	31 oz.
Water (Sterile) q.s. ad.......	32 oz.	32 oz.	32 oz.

If facilities for sterilization under pressure be not available there can be no doubt that immersion in antiseptic solutions is indicated.

Gauze, both sterile and medicated, is put up in convenient packages by the trade, and if facilities for sterilization be not convenient, these preparations will be found exceedingly useful.

Where elaborate dressing is necessary it is well to use gauze folded into a long strip about four inches in width. This is applied to the part in much the same way as a bandage (Fig. 189). Its removal, if saturated with secretions, is, however, attended with more disturbance to the patient than the "fluffed" gauze, which permits of ready saturation and piecemeal removal when the wound is redressed.

Cotton for the protective dressing has many advantages over the fluffed or roll gauze, and is applied in the vast majority of instances. It interferes mechanically with the entrance of bac-

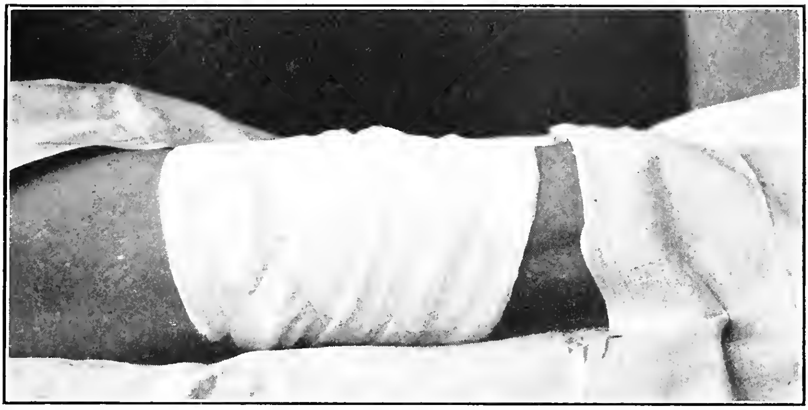


FIG. 189.—ROLL GAUZE APPLIED OVER FLUFFED GAUZE SHOWN IN FIG. 188.

teria, but is very readily saturated with secretions and, for this reason, is not as serviceable used next the wound as is the gauze. Absorbent cotton is readily obtained in the shops, and if it be used supplementary to gauze, need not be medicated, though in this

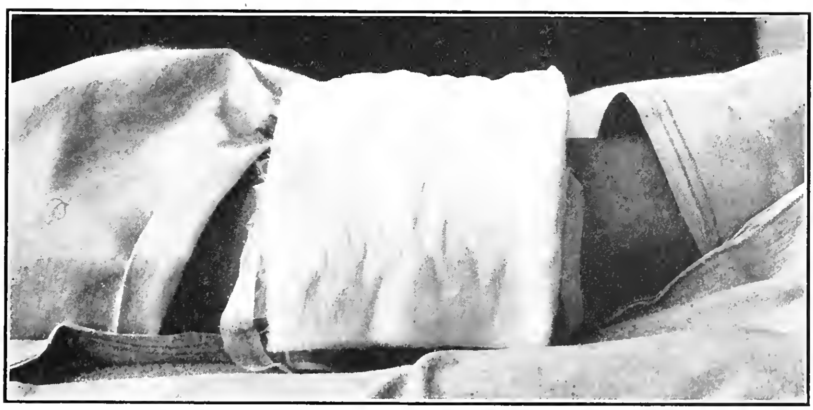


FIG. 190.—COMBINED DRESSING APPLIED OVER ROLL GAUZE SHOWN IN FIG. 189.

instance there is no objection to using it medicated if there be especial indication for its use. It has, however, a tendency to "ball" when applied, and is best employed in the form of combined dressing (page 77), which consists of a layer of cotton placed between two pieces of gauze. This is a very convenient dressing, and when applied presents a smooth surface which is easily held in place (Fig. 190) with several strips of adhesive plaster over which the retaining bandage is applied. With this arrangement of the protective dressing it is believed that the bacteria in the parts surrounding the wound are destroyed, or at least their growth is inhibited and their entrance from without effectually prevented. The attendant should err on the side of elaborate dressing rather than the reverse. A clear appreciation of the intent of the dressing will explain this admonition.

Oil silk, rubber tissue, paraffin paper, and other impermeable agents should, for obvious reasons, be applied between the bandage and the cotton. Secretion must be permitted to invade the dressing and not be confined close to the wound. If the impermeable layer be placed too near the wound, this will be prevented. The agents mentioned are valuable protection in regions where the dressing is apt to be soiled by excretions, such as the urine and feces. They are, too, very useful to retain moisture if, for any reason, the dressing needs to be kept wet.

The illustrations show the various steps in applying the protective dressing in a case of wound of the thigh. This site is selected for convenience. It is, of course, understood that the method of procedure applies equally to other situations.

CHAPTER XI

SHOCK AND SECONDARY HEMORRHAGE FOLLOWING OPERATIONS

Shock following operations—Shock bed—Treatment of shock: hypodermic injections; mechanical pressure; transfusion, the direct transfusion of blood, suture method of blood-vessel anastomosis, instruments and material, the operation; the cannula method of blood-vessel anastomosis: general management of a transfusion; the donor; the recipient—Infusion—Needling of artery—Hypodermoclysis—Enteroclysis.

Secondary hemorrhage following operations: The Mikulicz tampon; removal of Mikulicz tampon.

SHOCK FOLLOWING OPERATIONS

The two most important causative factors in shock from operations are the extent of trauma and loss of blood. These two factors do not, however, bear any direct proportion to the consequent manifestations in a given case. The variations in this regard may be considered as belonging to that mysterious problem called life. So-called life has been made the subject of more or less intricate investigation for ages. The problem is more wisely, if not with the hope of elucidation, turned over to the clergy. Certain it is that severe trauma may be attended with very little shock, and profound modification of the so-called vital forces may attend a comparatively moderate degree of injury. This is not quite so indefinite an outcome with regard to loss of blood, though here, too, the rule applies, if with somewhat less force. Comparatively slight loss of blood may be attended with considerable shock, though rarely, indeed, is great loss of blood not attended with shock, albeit this may be more severe in a given case than appears consistent with the quantity of the circulating fluid lost. In a general way, it may be said that loss of blood rarely entails shock of the same degree of severity as occurs with severe trauma, and that the former is more rapidly recovered from than the latter.

Indeed, persons who have received severe injury die very soon after the infliction of the trauma, while shock from loss of blood is compensated for by a physiological modification of functions which gives opportunity for compensation, as shown in cases of division of the common iliac artery with the knife, when the fatal outcome is quite delayed, in contradistinction to the immediate fatal result of injury to this vessel as the outcome of gunshot wound. In the latter instance the impact of the projectile is an important factor in the fatal issue.

An extended discussion of the mechanism of shock does not belong here. However, an understanding of the problem is necessary in order to comprehend the rationale of the treatment suggested. For a thorough acquaintance with this exceedingly important factor in the after-treatment of operative cases, the reader is referred to *Crile's* masterful work, "Surgical Shock."

Shock may be regarded as a sudden depression of the vital powers arising, as stated above, from trauma or loss of blood acting on the nervous system, and inducing exhaustion or inhibition of the vasomotor mechanism. Shock from mental emotion need not be considered here. By overstimulation of sensory nerves the vasomotor center is exhausted or inhibited, vaso constrictor power is lost, the arteries and capillaries are depleted or nearly emptied of blood, and the blood accumulates in the veins. The blood pressure is lowered, cardiac action is impaired, respiration is impeded, and quantities of dark colored blood collect in the somatic veins, but more especially in the veins of the splanchnic area.

In shock the abdominal veins and, indeed, veins in other parts of the body are distended, there is an insufficiency of blood in the arteries, and a lessened amount of blood reaches the heart and the vital centers of the central nervous system. This means that, while the total quantity of blood in the body may not be reduced, as obtains in cases of shock without loss of blood, sufficient blood is not circulating to maintain the functions of the vital centers.

Collapse is a term used to designate a severe condition of shock, and is employed by some writers as a name for a condition of shock produced by mental disturbance rather than by physical injury. *Crile* regards collapse as an inhibition of the vasomotor centers and shock as the outcome of exhaustion of these centers.

This conception is, however, not accepted by all writers. Shock and collapse may co-exist. Indeed, it may be said that if any difference exist between shock and collapse it is only as regards degree. Taking a comprehensive view of the rationale of the terminology, it would seem proper to regard collapse as a more severe degree of shock. At any rate, this permits of uniformity and avoids confusion. Shock is, of course, modified in degree, though, as already stated, no absolute standard can be made in this connection. As a general rule, shock is more severe in so-called nervous persons than in those of lymphatic temperament, and, of course, is more severe in persons suffering from organic disease.

Sudden death from shock is explained on the ground that a reflex stimulation of the nucleus of the pneumogastric nerve in the medulla occurs, which arrests cardiac action. This is called death by inhibition.

Anything which extracts heat from the body favors the occurrence of shock. This is a quite rational conception if it be true that animal heat and energy are mutually convertible. So it is also true that the conservation of animal heat during operative manipulations tends to prevent shock, and the application of artificial heat immediately following an operation would seem to meet one of the indications presented by the clinical picture of post-operative shock. As a rule, the bed of the patient is prepared with this in view while the operation is in progress, and as a routine the bed is in all institutions prepared in the following way.

SHOCK BED

As a rule, patients are best managed after surgical operations on a bed which has no mattress. Not infrequently considerable manipulation is necessary for the first few days after an operation, and this is best accomplished on a hard surface, as is obtained by the wire bed-spring. As already stated, the bed should be so located as to permit of easy access to the patient from both sides at the same time. The wire mesh spring is covered with a folded blanket and sheet. This is, in turn, covered with a rubber sheet corresponding to the middle third of the bed, and contact with the rubber is avoided by placing upon the rubber sheet a linen sheet

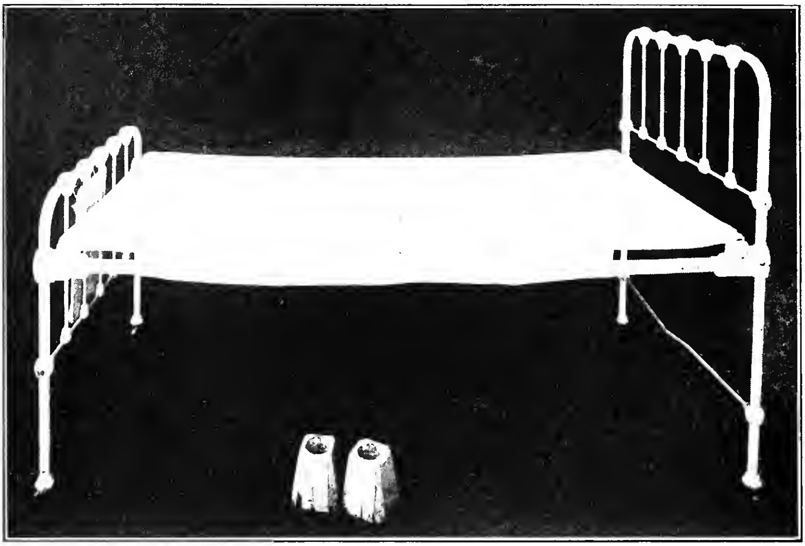


Fig. 191.—Shock Bed with Slip Sheet. Blocks for raising foot of bed.

folded on itself to the necessary size, and the ends twisted about the side bar of the bed, as shown in Fig. 191. The two blocks

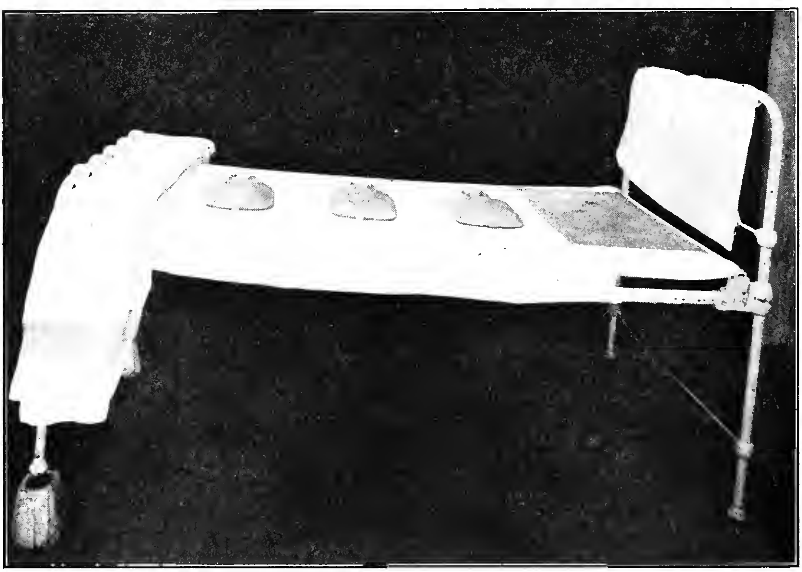


Fig. 192.—Shock Bed. With foot-end elevated and hot-water bags in place. The rubber sheet at head of bed prevents soiling with vomit.

on the floor are used to raise the foot of the bed, as shown in Fig. 192. Next three hot-water bags are placed on the bed and a small rubber sheet is laid at its head, with the view of preventing soiling of the bed linen from vomit, which is usually much in evidence immediately after narcosis. The center draw sheet, too, is very liable to be soiled as the outcome of involuntary evacuations from the bladder and rectum at this time, and the arrangement here shown permits of rapid change of this portion of the bed linen with a minimum of disturbance to the patient. Fig. 192 shows the bed arranged as mentioned with the top sheet and blanket turned down and the pillow fastened to the head of the bed ready to be placed under the patient's head when the necessity for its absence no longer obtains. Fig. 193 shows the bed completed

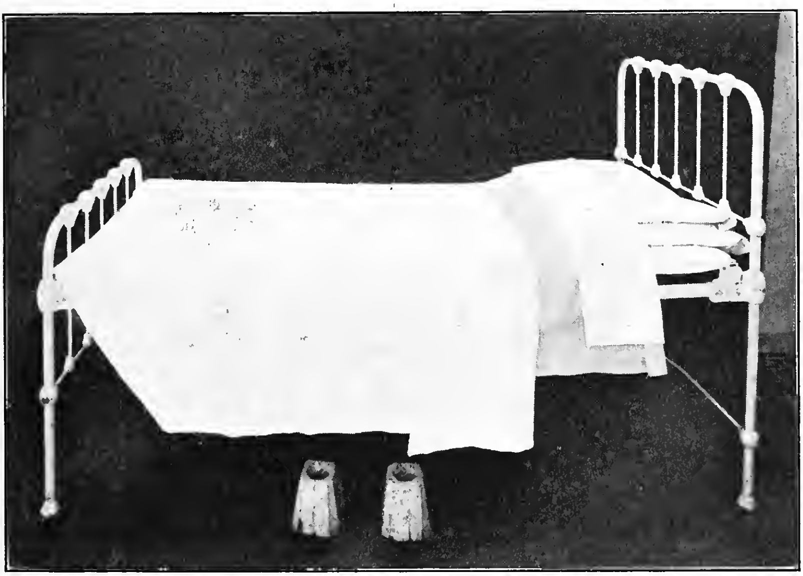


Fig. 193.—Shock Bed Completely Prepared for Receipt of Patient. Blocks are only employed when indication arises.

as it should be before the patient is placed upon it. This preparation is exceedingly elastic. The blocks are, of course, used only if shock occurs, thus aiding the circulation toward the vital centers by gravity. The hot-water bags are in the last moment removed from the center of the bed and placed in contact with the patient as the indications arise. Care should be taken not to burn the patient with the apparatus used to furnish artificial heat. It is to be remembered that the patient is not conscious at this time, and is in no position to standardize sensory impressions, and severe burns have occurred as the outcome of lack of precaution in this regard.

After the patient has been put to bed it is convenient to have close at hand a few articles which are used in meeting common

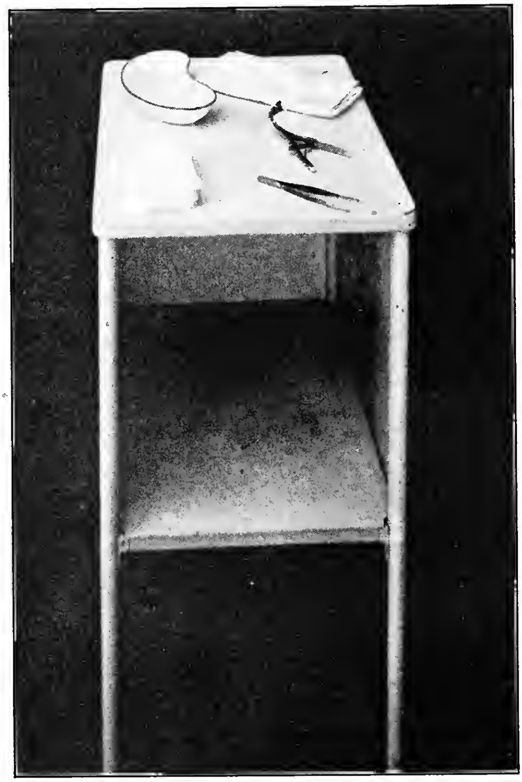


Fig. 194.—Bedside Table with Appliance Used Immediately After the Operation.

contingencies. A pus basin, towel, a few squares of gauze, a mouth gag, and a pair of dressing forceps are arranged upon a table placed at the bedside. Fig. 194 shows a serviceable arrangement in this regard. The pus basin may be apposed closely to the patient's cheek and effectually catches the vomit. In some instances the lower jaw is firmly apposed to the upper teeth and the vomit regurgitates and may be aspirated into the larynx and trachea. Indeed, it has happened that patients have choked to death from this cause. The mouth gag meets here the indication and is left *in situ* until sufficient consciousness recurs to obviate this possibility. As soon as the mouth is opened the gauze wipes are introduced into the pharynx with the dressing forceps, and the vomit removed. The towel is used to remove excessive quantities of vomit from the face. To facilitate removal of the vomit from the upper passages it is at times wise to raise the patient's shoulder with a pillow and turn the head to the opposite side, and to raise the foot of the bed with the shock blocks (Fig. 192).

These manipulations are routine and are employed after operations irrespective of whether shock occurs or not. The application of heat has already been shown to be a reasonable precaution with the view of preventing shock, and it is, of course, equally reasonable to assume that if unnecessary disturbances from vomiting be avoided this desideratum is additionally conserved.

In private practice or in an emergency this rather ideal condition of affairs may not be practicable. However, the hot-water bottles may be replaced by hot bricks, bottles filled with hot water, a hot stove lid, or, indeed, any apparatus which will accomplish the purpose. The table, too, need not be of white enameled steel, and equally good service will be rendered by an ordinary household table or a flat wooden chair.

TREATMENT OF SHOCK

Beyond the measures mentioned of conserving animal heat and aiding the circulation by gravity, the treatment of shock is in principle to be directed toward increasing the blood pressure by creating peripheral resistance either by drugs acting on the blood-vessels themselves or by mechanical pressure (*Crile*). The infusion of salt solution into a vein (Fig. 207) is of value, but its effect is transitory except in cases of loss of blood. The writer warns against the indiscriminate use of infusion of salt solution. It not infrequently happens that the house staff in the hospital will infuse in this way a patient who suffers from shock, the outcome of the severity of the operative trauma, and who has lost very little blood. In these cases saline infusion is not indicated. The indiscriminate use of strychnia is also deprecated. It is of little value as a stimulant except, perhaps, in collapse from mental impression. *Crile* has demonstrated this experimentally. Atropin, ether, digitalis, and alcohol should be given with caution, and only when especially indicated, though the writer is free to admit that these special indications are not clearly defined. In a general way, it may be said that they are of temporary service as supplementary to the methods more largely discussed here. It is difficult to see how amyl nitrate or nitroglycerin can be of use if the mechanism of shock is actually understood. Indeed, this conception is borne out clinically. Each of these remedial agents may have an especial field of usefulness in stimulating the heart, but they are of little service in the treatment of surgical shock.

The drug which has given palpable results and owes its beneficial action to an effect it produces by raising the blood pressure, which is in accord with our understanding of the mechanism of the affliction, is adrenalin chlorid. Adrenalin chlorid is on the market in a solution of 1 in 1,000. Ten to thirty minims of this may be given hypodermatically every one or two hours. It is, however, best to watch the effect of administration and vary the dosage and intervals of administration according to the indications as shown by the pulse and respiration. The agent may be added to the saline venous infusion or injected with salt solution under the skin or, as is perhaps most frequently done in cases where moderate shock is to be combated, added to the colic injection. The indications for its employment in the latter three ways will be taken up under a separate head.

Senn advises the administration hypodermatically of thirty minims of sterile camphorated oil every fifteen minutes. As the quantity of actively circulating blood is small, the amount of oxygen delivered to the tissues is greatly reduced. The inhalation of oxygen is, therefore, indicated. However, it is to be remembered that the red-blood corpuscles will take up only a certain amount of oxygen and their carrying capacity does not increase as the quantity of blood is reduced. This suggests that the remedy is of doubtful value. There is no objection to its use, however, and, indeed, as soon as the blood in the larger veins begins to circulate, respiration may be assisted in this way.

HYPODERMIC INJECTIONS

A word in this connection regarding hypodermic injections. The usual practice is to employ for the purpose a long needle (Fig. 195A), which is obliquely introduced through the skin as it is "pinched" up by the other hand (Fig. 196). The objection to this is that a considerable number of hair follicles and glandular elements of the skin are punctured, favoring infection and subsequent abscess formation. Again, a wide area of sensory terminal fibers are subjected to trauma, causing considerable pain. The writer orders the injection made with a very short, slender needle (Fig. 195B), which is introduced at right angles to the surface of the skin (Fig. 197), thus avoiding the contin-

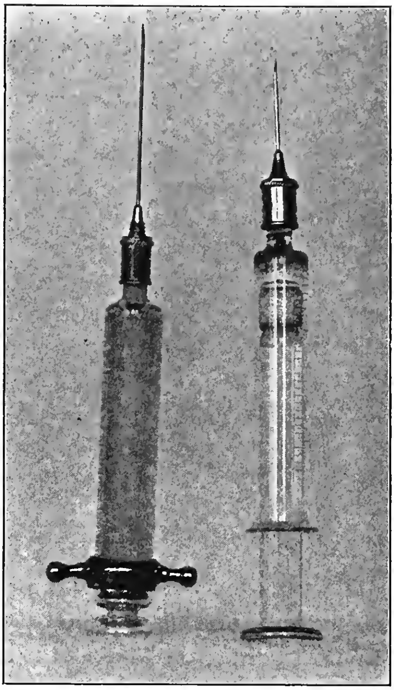


Fig. 195.—Hypodermic Syringes. *A*, Long needle usually employed. *B*, Short needle.

Fig. 196.—Usual Method of Making Hypodermic Injections.

gencies mentioned. Small as this difference may seem, it is an important factor when repeated injections are to be made in rapid

Fig. 197.—A Useful Method of Making a Hypodermic Injection.

succession. A lesson in this regard may be gleaned from morphin habitués, who use this method and are but rarely afflicted with abscess.

MECHANICAL PRESSURE

Mechanical pressure may be made by firmly bandaging the extremities with textile fabric or, better still, with elastic rubber

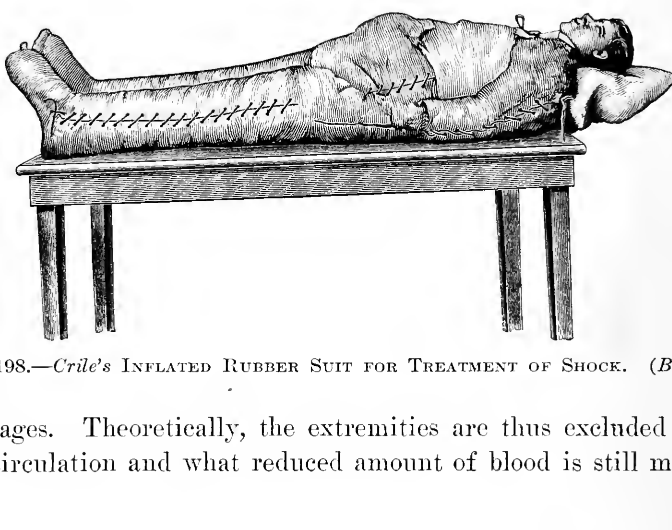


Fig. 198.—*Crile's* Inflated Rubber Suit for Treatment of Shock. (*Bryant.*)

bandages. Theoretically, the extremities are thus excluded from the circulation and what reduced amount of blood is still making the cycle is restricted to the vital organs. This measure is a simple one and is useful. It should be done rapidly so as not to unnecessarily expose the patient to the influence of the atmosphere.

Crile employs a complete double rubber suit (Fig. 198), which completely encases the patient, and the space between the two layers of rubber is inflated with air. This is perhaps of considerable service, but its field of application must of necessity be restricted to a certain class of cases and under certain conditions.

TRANSFUSION

Transfusion is employed to overcome shock. Blood introduced directly from one person to another, or the introduction of defibrinated blood, has been largely used for the purpose. However, with a better understanding of the mechanism of shock, the introduction of saline fluid into the body has largely displaced the former method. The intent of the introduction of fluid into the circulation is not to supply nutritive constituents to the body of the afflicted, but to furnish a mechanical agent upon which the circulating organs can work until the normal relationship is established. The object is accomplished mechanically by a salt solution as well as by blood either directly from another or defibrinated outside the body by mechanical manipulation, and is not liable to undergo chemical changes either in the technic of introduction or in the body of the recipient which might have deleterious effects.

Heretofore the avenue of communication between the donor and recipient has consisted of mechanical appliances, and if it be true that coagulation of the blood is prevented in the body as the outcome of contact with living tissue, the passage of the circulating fluid through the cannula must of necessity permit of a certain chemical change in the blood which may result in coagulation and, perchance, the formation of emboli. This does not apply to defibrinated blood with regard to emboli, but it is difficult to see how blood which has been subjected to the necessary extrinsic manipulations which obviate clotting can be of use in any other than a mechanical way.

The objections with respect to the direct method of transfusion of blood have been largely overcome by the technic employed by *Crile*, from whose work, "Hemorrhage and Transfusion," the text on this subject is quoted.

Crile states:

The transference of blood from one individual to another can be safely and efficiently done only by the union of the supplying vessel of the donor to the receiving vessel of the recipient in such a manner that the continuity of the intima of each vessel is continuous with that of the other.

The problem is applied, in this connection, only to shock. The question of hemolysis is, of course, not taken up at this time for this reason.

The Direct Transfusion of Blood.—By following *Carrel's* technic it is possible to sew together the ends of two severed blood-vessels in such a way that when the blood is allowed to flow through, the joint does not permit leakage, the flow is uninterrupted, and clotting does not occur. This method can not only be used for temporary anastomosis, but for permanent restoration of function. As developed by the author, in performing transfusion directly from one individual to another, the suture method was employed in all early experimental and clinical work, but it was found that a special cannula and method of using it took less time. In the latter work the cannula has come to supersede the suture for making all temporary anastomosis. Both methods, however, will be described in detail.

The operator will find the technic of the direct anastomosis without special cannula of valuable service in instances such as arise in connection with surgical operations, in the event of the necessary special instruments not being available.

The Suture Method of Blood-vessel Anastomosis.—*Instruments and Material.*—From an experience with over 100 blood-vessel anastomoses made in the laboratory, and more than 60 clinical cases, the following instruments and materials have been found to be most helpful. (See, also, Fig. 199.)

1. Scalpel.
2. Blunt director.
3. Small, sharp-pointed, straight scissors for dividing the vessels, snipping off fragments of the adventitia, etc.
4. Ordinary dissecting forceps.

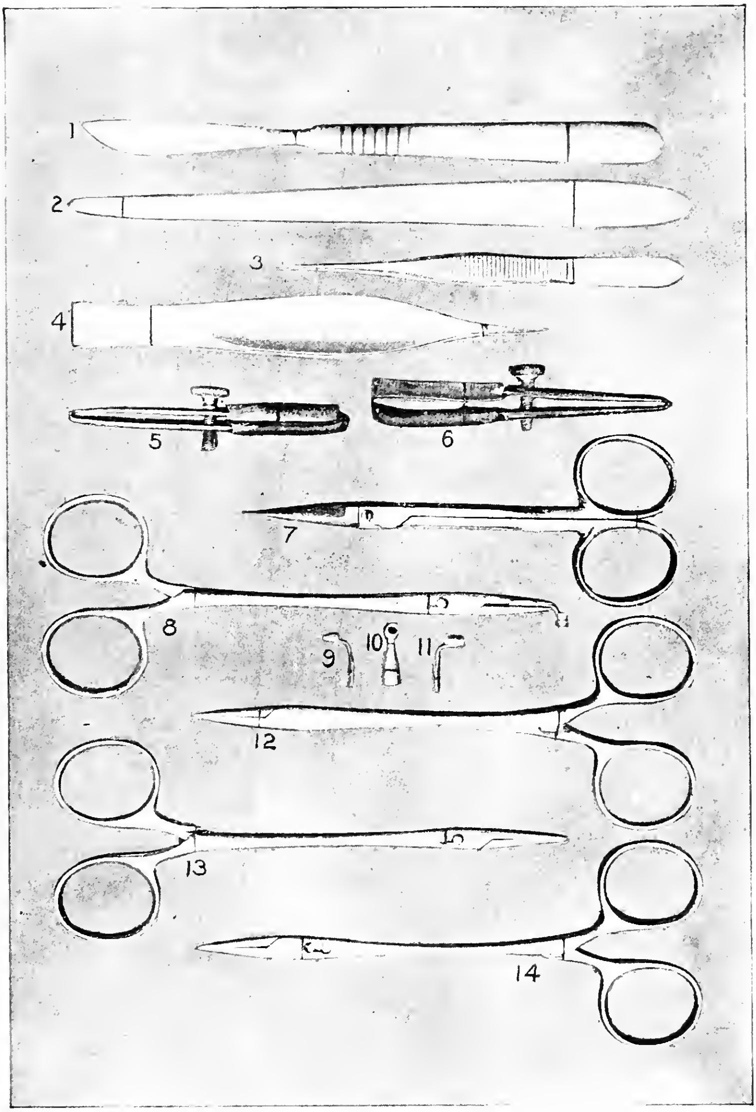


FIG. 199.—INSTRUMENTS USED IN PERFORMING A TRANSFUSION BY END-TO-END ANASTOMOSIS BY THE CANNULA METHOD. 1. Scalpel. 2. Blunt dissector. 3, 4. Fine-pointed forceps. 5, 6. *Crile* clamps for temporary closure of blood-vessels. 7. Fine-pointed scissors. 8. Hemostat with transfusion cannula locked in place. 9, 10, 11. Three of the set of four cannulæ. 12, 13, 14. Mosquito hemostats for placing the blood-vessels. (Reduced to about one-half actual size.) —*Crile.*

5. Minute tissue forceps with exact approximation at the points (those used by watchmakers have been found to be useful).
6. Half a dozen mosquito hemostats to use in securing the minute branches of the radial artery and the small venous branches.
7. A pair of small *Crile* artery forceps.
8. No. 16 English needles (*Kirby's*).
9. No. 1 Chinese silk.
10. Sterilized vaselin.
11. Ordinary means for closing a wound, and dressings.

After experimenting with different kinds and sizes of needles it has been found that the No. 16 round needle as made by *Kirby*, of London, is the best. A No. 14 or 12 size is larger and easier to handle, but has the disadvantage of causing unnecessary traumatism of the intima and tends to permit oozing through the needle holes when under pressure. Any other than a round needle of about this size will be found to be unsatisfactory.

As a No. 16 needle is scarcely larger than a hair, the problem of threading it is a difficult one. The method finally adopted to secure suitable sutures was to take a piece of the No. 1 Chinese silk or "000 linen" about 2 feet in length, attach a hemostat to the lower end, carefully separate the upper end into its component strands for a long enough distance to permit each being grasped by the hands of the operator and a hand of an assistant, and then, allowing the hemostat to swing free and pull downward as the twist in the silk made it revolve, hold the silk until it was untwisted down to the hemostat. This gave strands capable of being threaded through the tiny eye of the needle, and with these strands the sewing was done.

In order to thread a needle, such a strand is gently pulled at the end in the direction of its long axis until the end breaks. This leaves tiny fibrils, which may then be twisted together and passed through the eye. To preserve the threaded needle, it is passed in and out at 2-inch intervals through a long, narrow strip of gauze, from which it can easily be withdrawn when needed. By placing several threaded needles in one strip they may all be sterilized together.

Operation.—Having the ends of the vessels to be united sufficiently near each other, the adventitia of the artery is drawn down over the end by means of the fine-pointed dissecting forceps, and cut squarely off with the small straight scissors. By so doing the adventitia left on the vessel retracts and leaves a free field for inserting the sutures. The vein is likewise prepared. Then, with the fine silk strand thoroughly saturated with sterile vaselin or oil, the needle is passed through all the coats of the artery from without inward near the cut surface, and passed through the end of the vein wall in the opposite way. The two vessels are brought intimately in contact by tying the suture. The ends of the suture are not cut close to the knot, but about four inches from it. This gives a stay suture to hold while completing the technic. Two more similar stay sutures are inserted with the circumference of each vessel divided into thirds between them, and if the stays be drawn taut the closely approximated ends of the artery and vein are divided into three equal parts, so as to form an equilateral triangle (*Carrel* and *Guthrie*).

With the three stay sutures successfully placed the problem becomes a comparatively easy one. Tension is brought to bear on any two of the stays—it is immaterial which two as long as the third one lies underneath. On the third stay an inch below the vessels is attached a mosquito hemostat which is allowed to pull them down, and

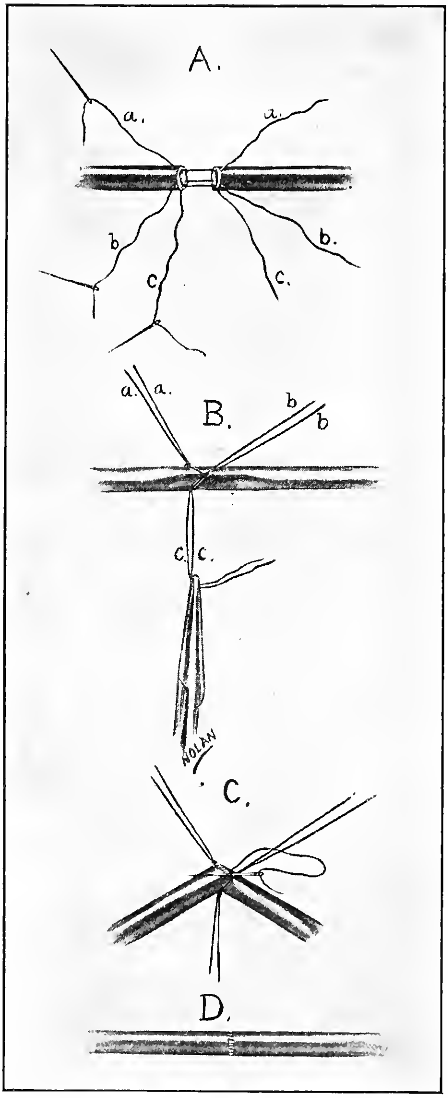


Fig. 200.—Diagrams of Stages of End-to-end Anastomosis of Two Blood-vessels by the Suture Method. (*Carrel.*) *A*, Method of placing the three stay-sutures. They are equidistant and pass through the entire thickness of the vessel walls. *B*, The stay-sutures tied, and the lower angle retracted by the weight of a hemostat. *C*, placing the over-and-over continuous suture between two of the stay-sutures. The vessels are lifted by the upper sutures in the hands of an assistant, so as to make an angle between the vessels. This permits easy sewing with the straight needle. *D*, The anastomosis completed. (*Crile.*)

thus prevent the needle from being passed through the lower part of the vessel walls when the final sutures are placed. The weight of the hemostat is too small to damage the walls, but great enough to insure complete retraction of the lower angle. With the three stays thus held a continuous over-and-over suture is run between the upper two, placing the stitches as close together and as near the ends of the vessels as possible, except near the stays, where they are placed a little farther away in order to include the stay stitch holes. With one third completed, the tension is shifted to the next two stays, and the hemostat shifted to the third stay, which is thus brought underneath. This is repeated once more, and by that time the anastomosis is complete and ready for the blood to flow through. It should be remembered that the venous clamp should always be removed before the arterial clamp. If this is not done the blood rushes against the venous clamp under arterial pressure, and throws too great strain on the anastomosis, and may cause leakage. Even if one or two drops of blood exude when the clamps are properly removed no further leakage will follow, provided, of course, that the sutures have been properly placed. The operation is one of great delicacy, and it is essential that the vessels should be handled with extreme gentleness, and just as little as possible, to avoid running any risk of causing clotting (see Fig. 200, *Crile*).

The Cannula Method of Blood-vessel Anastomosis.—While *Dr. S. J. Mixter,* of Boston, was the first to call the author's attention to the possibility of this method, *Queirolo,* as far as has been ascertained, was the first to use an anastomosis tube in blood-vessel surgery as it is used at the present time. Even then the fundamental principle did not originate with him, but with another investigator, who used it in making intestinal anastomoses. Later *Payr* developed the idea much more extensively, and was the first to suggest using tubes made of magnesium (the metal) which would be absorbed in the tissues and permit the formation of permanent anastomoses. Neither *Payr* nor *Queirolo* employed the short handle attached to the tubes which permits easy control with hemostatic forceps until fixed in place—an essential improvement. *Payr* suggested holding them by means of clamp or other forceps with fine points which could be inserted into the lumen of the tube with the entering vessel, but it is obvious that this method would not be utilizable with very small vessels owing to lack of room in the tube.

Queirolo's description of his method is as follows: "The isolated portion of the portal vein is drawn through a short glass tube, pulled back over its forward edge, and bound firmly upon it. . . . The glass tube thus covered by the vein is now drawn into the free end of the vena cava, which is then bound on the glass tube, so, however, that the first loop which fastens the portal vein is not covered by the vena cava. The artery compression forceps are loosened, and thereupon the blood streams out of the portal vein into the vena cava without touching a foreign body, and only coming in contact with the vessel endothelium, for the first loop touches only the outer wall of the portal vein, and the second loop only the outer wall of the vena cava. . . ." (*Moleschott, Untersuch.,* 1895, xv, 228-40).

The cannula such as the author now uses was developed in collaboration with *Dr. F. W. Hitchings.* To be able to use vessels of different sizes different-sized cannulæ have been made, the smallest with an inside diameter of 1.5 mm., the next half a millimeter larger, and so on up to 3 mm. It has been found by experience that this range covers all ordinary cases in the human subject.

The instruments used when the cannula is employed are the same as those used in carrying out the suture technic, except that the cannula replaces the No. 16 needle and fine suture. The vessels to be anastomosed are exposed in the same way (the details will be described under the heading of the general management of a transfusion in the following pages), and after selection of a cannula of size suitable to the size of the vessels the end of the vein is either pushed *through* the handle end of the cannula with the help of fine-pointed forceps, or pulled *through* by means of a single fine suture inserted in its edge, the needle being left on the suture and passed through the cannula ahead of the vein. The handle of the cannula is then tightly seized by a pair of hemostats (the fingers are too clumsy), three mosquito hemostats, or small, self-locking forceps such as oculists use, are snapped at equidistant points on the end of the vein, taking care not to have the tips extend up into the lumen more than is necessary to get a firm hold. The end of the vein is then cuffed back over the cannula by gentle simultaneous traction in the three hemostats, and tied firmly in place with a fine linen thread in the groove *nearest to the handle.* The cuffed part is next covered with sterile vaselin, being careful not to get any into the open end. This facilitates slipping the artery over the cuff. The hemostats are removed from the vessel edge, and the artery may then be put in place.

Owing to the elasticity of the arterial wall it usually shrinks considerably when the pressure from within is removed, as it is at the free end. To obviate this it may be necessary to dilate the end *very gently* by inserting the closed jaws of a mosquito hemostat covered with vaselin, and opening them for a short distance. The three hemostats are then applied to the edges just as with the vein, and the artery is gently drawn over the cuffed vein on the cannula and tied in place with another fine linen suture applied in the remaining groove. The mosquito hemostats are removed, and finally the large hemostat which has been snapped on the handle of the cannula during all this time is removed. The process is then completed. After the transfusion the cannula is removed, both artery and vein are ligated, and the wounds are sutured (see Fig. 201.)

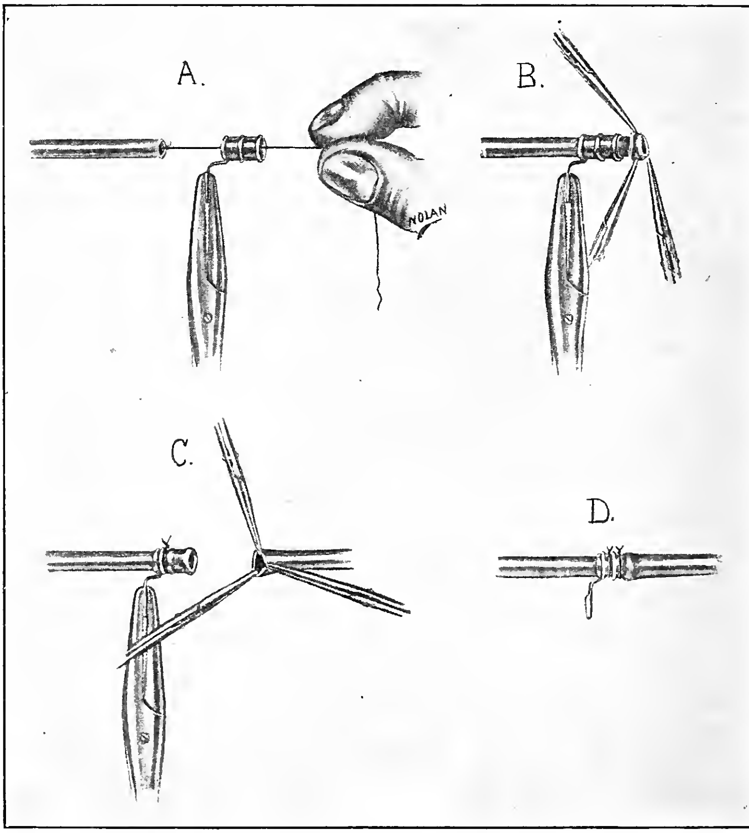


Fig. 201.—Diagrams of Stages of End-to-end Anastomosis of Two Blood-vessels by the Cannula Method (as modified by *Crile* and *Hitchings*). *A*, Pulling the vein through the cannula. Very fine pointed forceps may be substituted for the single suture. *B*, Cuffing back the vein over the cannula with three mosquito hemostats. *C*, The vein cuffed and tied in place in the groove next to the handle of the cannula. The artery is ready to be drawn over the vein. *D*, The anastomosis completed, and the cannula hemostat removed. The artery is tied in the remaining groove. The short handle of the cannula is so light in weight that it does not cause torsion of the vessels. (*Crile.*)

In making a cannula anastomosis experience will show what size cannula is suitable for the given vessels. As large a size should be used as possible without injuring the intima of the artery by stretching it too much. Usually there will be no difficulty in obtaining a large vein, but the artery may be very small. If too small a cannula is used, the amount of the flow will be diminished. Moreover, too large a vein will take up too much room in the cannula, and the amount of flow be diminished.

The author has never yet found a radial artery so small that the three mosquito hemostats could not be applied to its edge to draw it over the cuffed vein. If preferred, three stay sutures may be used instead of the hemostats, but they will tear out much more easily, and are not so easily or so quickly applied. In the earlier cases the artery was cuffed back instead of the vein, and the vein pulled over. It was found that cuffing back the artery in man obstructed the lumen of the cannula too much, and was often a very difficult procedure, especially when the wall was at all calcified. Besides, with a calcified wall there was too much danger of tearing the intima in the process of cuffing. Apparently there is no danger of clotting when done either way, but to cuff back the vein is the better method.

In using the cannula two facts should be particularly remembered. The first is that the long axis of the tube should coincide with the long axis of the lumen of the vein and artery. A little experimenting will show how easily the cannula may be made to slant so that the opening in it will come almost in contact with the artery wall, and shut off the flow in great part or completely. Actual experience has shown the necessity of placing the cannula accurately.

The second and less obvious fact is that unless the right amount of tension is maintained on the vessel which passes through the cannula when the blood is flowing across, particularly with a small cannula, the flow will be diminished or shut off altogether by the elasticity of the vessel wall on tension in the cannula pulling the outside part of the vessel in and blocking the way. This is more likely to happen with the artery drawn through the tube than with the vein, owing to the greater elasticity of the arterial wall. It may be very prettily demonstrated by drawing an artery through a small cannula, cuffing it back, and tying it in place. On removing the clamp controlling the flow no blood will appear at the open end of the artery, or at most the flow will be very small and weak. On putting gentle tension on the tube by drawing it out a little in the direction of the long axis of the artery, the wall puckered up in the cannula will be pulled out and the blood will spurt sometimes as far as three feet.

The exposed vessels should be kept moist with warm normal saline solution. Not only is drying harmful, but the flow is increased through gradual relaxation of the arterial wall.

Experience has shown that if anything goes wrong in carrying out this technic it is best to start again from the beginning, and not to try to get around any of the details by substitution. For example, if one of the three mosquito hemostats slips from the end of the vessel which is being either cuffed or drawn over, the attempt should not be continued until the vessel has been removed and the hemostat is accurately replaced. Not only will valuable time be lost in trying to substitute ordinary forceps for the slipped hemostat, but the danger of tearing the intima is much greater. For the average surgeon, at least, it is essential to have the instruments lock firmly in place on the vessel edge. Then, if one be dropped from the hand it does not have to be reapplied when picked up. For this reason ordinary forceps are entirely unsuitable, and anyone endeavoring to use them takes on himself the responsibility of the possible occurrence of clotting, or of inability to finish the technic. Every detail has been worked out over and over again, and while there is doubtless plenty of room for improvement, it is felt that every detail should be exactly followed, at least until the operator has convinced himself that any modification is suitable. It will be found that the use of the anastomosis cannula is much less difficult than the use of the suture method, the results are more certain, and the time of operation much shorter.

The General Management of a Transfusion.—Having carefully considered the technic of end-to-end anastomosis of blood-vessels by the suture and cannula methods, we come to its practical application in performing direct transfusion from one human being to another. First of all a suitable donor must be obtained. It is assumed here that all the requirements have been successfully met, and that both donor and recipient are in readiness.

It is of great advantage to have a thoroughly trained corps of assistants. A full staff would include first and second assistants, a nurse to handle the sponges, sutures, etc., a nurse to devote herself entirely to the comfort of the patients, an instrument nurse to pass between the operating and sterilizing rooms, and an orderly. If special investigations are to be made—for example, of changes in the blood—others must be added as needed. All should be able to work noiselessly and rapidly.

The operating room should have all the ordinary equipment. Two operating tables are necessary, one for each patient. They should be of the type which allows the patient to be easily changed from a horizontal to a head-up or head-down position, so as to permit combating either cerebral anemia or acute cardiac dilatation. They should be well provided with pillows with which to make the patient as comfortable as possible. Two small square tables of the same height as the operating tables are also needed—one for the instruments, and the other to support the arms of the patients. Two low stools, one for the surgeon and one for the first assistant, complete the list.

From twenty to thirty minutes before being brought to the operat-

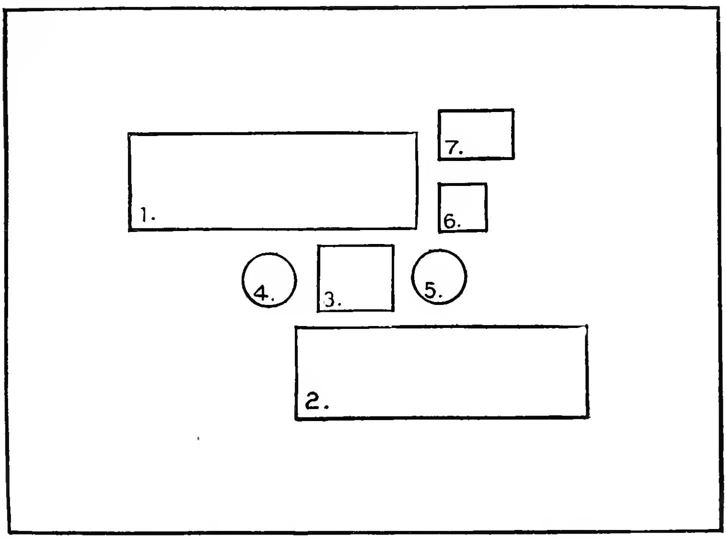


Fig. 202.—Diagram of Arrangement of Operating Room for a Transfusion. 1, 2. Operating tables for recipient and donor, respectively. 3. Table for arms of recipient and donor. 4, 5. Stools for surgeon and first assistant, respectively. 6. Instrument table. 7. Table for dressings, sutures, etc. (*Crile.*)

ing room the donor and recipient each receive 1/4 of a grain of morphin hypodermically, unless there is some special reason for its being contraindicated. The patients are assured that they will experience no pain beyond the first needle prick.

When each is in place on his respective operating table the tables are arranged so that the left arm of each will rest comfortably on the small square table placed for the purpose between the operating tables (see diagram, Fig. 202). In order that no glimpses of the surrounding room may be had the face of each is covered with a damp towel "to avoid too much bright light and headache." The operator and first assistant sit between the operating tables on opposite sides of the small square table. The other small square table with the instruments on it is placed conveniently for the second assistant. The patients are again told that there will be no pain beyond the first prick. The nurse detailed to care directly for the patients relieves the monotony of waiting by changing the wet towels, bathing the forehead, giving water to drink if desired, and in short doing anything permissible to afford comfort.

The next step is the dissection of the blood-vessels to be used. Experience has shown that it is best to use a radial artery of the donor and any superficial arm vein of the recipient near the elbow. Usually the median basilic vein is the best one on account of its size and easily accessible position.

Local anesthesia is obtained by injecting cocain in 1/10 of 1 per per cent. solution with a few drops of 1-1,000 adrenalin chlorid solution. Several hypodermic syringes should be ready so that there need be no delay on account of having to stop to refill a single one. The injections are first made into the skin, and then more deeply around the vessels. After this, firm pressure is applied by the hand over a gauze sponge to insure thorough spreading of the cocain through the tissues. When carefully performed there is absolutely no pain in any part of the technic until the sutures are placed in the skin at the end of the transfusion. By then the effect of the cocain has usually worn away.

In making the dissection it is necessary to have good light. Mosquito hemostats are used to catch every vessel that sheds even a drop of blood. The field should be kept absolutely clear. The donor's radial artery is isolated for a distance of about 3 cm. at the point of election in the wrist. Here there are a number of small side branches which must be carefully isolated and tied with No. 1 Chinese twist silk (which has not been split up into strands) before being cut. The artery is then tied at its *distal* end, and a *Crile* clamp is gently screwed in place over the proximal part as near to the place where it comes out of the undissected tissues as convenient. The clamp should be screwed up with great care. Just enough pressure should be used to control the flow of blood without causing injury to the vessel wall. The artery is severed with sharp scissors a short distance from where it is tied off, the end cut squarely across, the adventitia pulled down and cut off as directed under the technic of making an anastomosis by either the suture or the cannula method, and is then ready for the completion of the anastomosis. The result should be that the operator has about 2½ cm. of exposed radial artery free from branches,

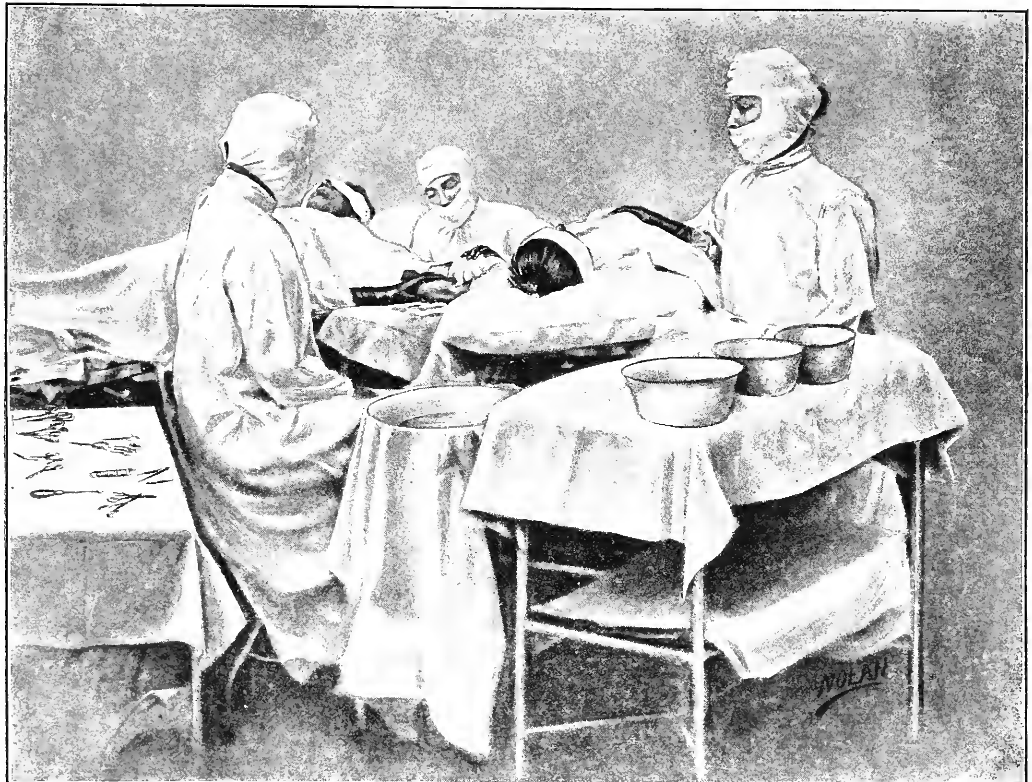


Fig. 203.—A Clinical Transfusion in Progress. The donor is on the right, the recipient on the left. The actual connection between the artery of the donor and vein of the recipient is hidden between the arms. (*Crile.*)

the cut end open, and the blood prevented from coming out of it by the clamp.

The next step is the dissection of the vein. It is exposed for the same distance as the artery, the branches are tied off in the same way, and the ligature is also applied at the *distal* end. The second *Crile* clamp is applied just as before, the vein cut near the ligature, and it in turn is ready for the completion of the anastomosis.

The anastomosis is made either by the suture or the cannula method as described in the previous pages. The details will not be repeated here. It may be said that in practically all cases the cannula method should be used rather than the suture method. In order to meet possible emergencies, however, the operator should be prepared to carry out either. It seems to the author that neither should be attempted on the human subject until experience has been gained in the laboratory.

With the anastomosis completed, the questions which then arise are how much blood should be allowed to pass over, how fast to allow it to pass over, and what will happen if the limits of safety are passed. So many points must be considered in answering these and other questions that the problems presented by the donors and recipients will be discussed separately.

The Donor.—It has been proved many thousands of times, either directly through hemorrhage or indirectly through transfusion, that loss of blood to even a considerable amount may occur and the individual survive. In normal individuals lost blood is quickly replaced.

Another fundamental fact is that while the blood of the donor may convey life to the sick person, it may also convey death in the form of disease. As far as can be determined the giver of the blood should be free from any constitutional or other disease which might be engrafted on the patient.

A donor may usually be readily obtained. Both men and women are suitable. In cases in which no immediate hurry exists the best subject is selected from among the relatives and friends who are willing to serve. The gravity of the patient's condition and the reason for wishing to transfuse are carefully explained in detail, and the painlessness of the operation to both donor and recipient is assured. Almost always the offer to serve is made voluntarily. In fact an entire family and numerous friends have frequently been eager to do so.

The only difficulty which has been encountered thus far has been among ignorant people, who may have a certain amount of distrust of both surgeons and hospitals. Even among such people, however, but one refusal has been experienced. In this particular case the parents of the patient, a nine-year-old child whose legs had been crushed, refused to assist, their argument being that the child was so much mutilated by the injury that it was not worth saving!

In two instances among the author's cases donors were hired. In these instances the commercial attitude was apparent, and they were not as tractable as those who responded to the appeal of sentiment.

After the donor has been selected he is subjected to a thorough cross-questioning as to his family and personal history, and a thorough physical examination. This is for his own benefit as well as for the benefit of the patient, as in some cases it has been proven inadvisable to bleed the would-be donor.

In all the author's cases the regeneration of the blood lost by the donors was uninterrupted and rapid. This statement is based on their general appearance subsequent to losing the blood, their freedom of symptoms suggestive of the experience through which they had passed, and, more particularly, on the blood examinations made in as many cases as was possible under the particular conditions of each individual case. In no case was there anything but a temporary disturbance of the general functions. Apparently the return to normal varied directly according to the amount of blood lost—the more that was lost the longer the lapse of time before the return to the original amount.

The amount of blood which is allowed to pass from donor to recipient varies according to a considerable number of factors. These may be tabulated as follows:

1. The duration of the flow.
2. The size of the radial artery and the elasticity of its wall.
3. The blood pressure of the donor.
    a. The normal pressure.
    b. The pressure as affected by psychic influences.
4. The method of making the anastomosis.
    a. The suture method.
        (1) The accuracy with which the suture is made (leakage, reduction of size of lumen).
    b. The cannula method.
        (1) The accuracy with which the connection is made (turning the tube sideways).
        (2) Adaptation of cannula to size of vessel.
        (3) The tension on whichever vessel passes through the cannula (see previous explanation).

(4) Whether the vein or the artery passes through the cannula (on account of the varied thickness of wall).
(5) The resistance offered by the vascular system of the recipient.

It is necessary to discuss but two of these factors here, as the others are discussed in appropriate places elsewhere. From the donor's standpoint the *duration of the flow* is an important consideration. The best way of determining when to stop the flow is by watching his symptoms. At first he will show loss of color in his mucous membranes, pallor of the skin, slight uneasiness, slight quickening of the pulse and respiration, lowering of the blood tension, and beginning shrinkage in the skin of the face. Progressive hemoglobin determinations often furnish a good index of the general condition, and may be easily made. All of the symptoms are progressive, and as soon as they are well marked the flow should be stopped. Often the condition of the recipient will necessitate this long before the donor shows any symptoms at all. Definite rules cannot be laid down. Everything will depend on the judgment and experience of the surgeon. Temporary cerebral anemia can be readily controlled by changing the donor from the horizontal to the head-down position.

The approximate determination of the amount of blood which is lost can be made by carefully weighing the donor to fractions of an ounce before and after the transfusion. The conditions of the weighing must be the same at each time. It is futile to attempt to calculate the amount of transfused blood from direct observation of the loss of a few cubic centimeters in a given time from the radial artery. A few experiments have been done in the laboratory which showed how much the rate of flow varied as the flow progressed, and how useless the attempt was to obtain accurate calculated results.

That the blood-pressure may be markedly varied by reason of psychic influences has been repeatedly demonstrated by many different observers. It is largely for this reason that the elimination of disturbing influences at the time of the operation is so important. This is accomplished not only by the previous dose of morphin, but by the noiselessness of a perfectly equipped and smoothly run operating room.

A final point must be considered in regard to the protection of the donor against injury, and that is the possibility of his becoming infected from contact of his artery with the vein of the recipient in cases in which transfusion is performed for an infectious disease, and, more particularly, one which is acutely infectious. In the author's cases of hemorrhages in typhoid fever the donors were purposely chosen because they had had typhoid. The possession of immunity would in itself protect the donor in such a case as well as the unusual care taken to avoid exposure. The author believes that there is little or no risk in a chronic infection like tuberculosis or from an old septicemia or mixed infection. This is largely due to the fact that there is no chance for the blood being forced back from the recipient into the donor against the donor's arterial pressure. At the end of the transfusion there is a good margin of safety as regards any of the possible infection in the vein of the recipient being retained by the donor, as the donor's artery may be severed at least 2 cm. from the point of anastomosis. Moreover, the exposed tissues may be freely irrigated with corrosive sublimate in 1-2,000 solution. The exact amount of risk from this source must be very small, and with care as suggested it hardly seems likely that the danger of infection need ordinarily be feared. At all events, cases of acute infection rarely require transfusion.

The Recipient.—The question as to what pathologic conditions may be suitably treated by transfusion of blood from one human being to another has not been definitely settled. The most that can be said at present is that it is clearly indicated in certain conditions and as clearly contraindicated in certain others. With our present knowledge the author feels that it should be used only when all other resources at command have failed.

Cases are on record in which transfusion was said to have been followed by recovery when in reality the patient died of the disease, and on the other hand deaths were said to have occurred from the disease when they should undoubtedly have been ascribed to accidents of transfusion.

As far as the recipient is concerned, transfusion is a problem in mechanics as well as in therapeutics. There are certain dangers which must be avoided under both of these headings, and in the recognition of their existence and their successful avoidance lies the responsibility of the surgeon. There are few if any operations in which more factors must be considered, and in which more care must be exercised.

From the mechanical standpoint the chief danger to be feared is acute cardiac dilatation and subsequent cardiac failure caused by transfusion in excessive amount or at excessive rate of flow. This danger is particularly great when the vitality of the patient is much lowered in the course of a severe illness, or when any previous functional or organic cardiac complication is present. Fortunately, as has been frequently shown in the author's series of cases, a certain amount of dilatation may occur and pass rapidly away without causing either immediate or subsequent harm.

The best treatment of acute cardiac dilatation is prevention. If the blood-pressure of the donor is high and his radial artery large, too rapid a flow may be prevented by partially narrowing the lumen of the artery with gentle pressure of the fingers. The effect can be gauged by the changes in the strength of the pulsation beyond the cannula in the vein. It may be necessary to shut off the flow altogether for short intervals, giving the heart a chance gradually to assume its added burden by allowing only small amounts of blood to pass across at a time.

As another means of prevention of acute cardiac dilatation, it may be necessary to bleed the recipient freely before transfusion. In cases of shock or of acute hemorrhage a preliminary bleeding would do harm. In many cases of subacute hemorrhage it is unnecessary. In all other cases either a preliminary bleeding must be performed or the amount of blood transfused must be much smaller than would otherwise be possible, and the care taken correspondingly great. It should be remembered that reduction in the corpuscular elements in the blood of the recipient does not necessarily mean reduction in the fluid content (as, for example, in pernicious anemia), and also that where saline infusion would rapidly pass out of the vascular system blood will be retained. In cases where great weakness of the patient is associated with marked reduction of the red corpuscles it may be unsafe to bleed unless the bleeding be done at the same time that the transfusion is progressing.

Another phase of the mechanics of transfusion is the possible transudation of the blood into the tissues or body cavities with or without rupture of small vessels in the parenchymatous organs. This possibility may be disregarded in human beings, as symptoms of cardiac distress will occur long before there is any danger of transudation.

The principal symptoms of acute cardiac dilatation are dyspnea, distress or pain in the precordial region, cough, and cyanosis. The pulse increases in rate and may be very irregular in action, tension, and volume. The right heart is chiefly affected. Percussion over the right border may give dullness extending out as far as an inch from the border of the sternum. Unless the strain on the heart is immediately relieved the increase in severity of the symptoms is rapid, and, if allowed to go too far, death will result. The rapidity with which a heart will dilate and return to its previous size is sometimes remarkable. This fact should never be counted on, however, as a means of getting out of difficulties brought on by over-transfusion.

When acute dilatation has once occurred it must be promptly recognized. The transfusion must be stopped, the operating table tilted so as to raise the patient to the head-up position, and rhythmic pressure made on the chest over the heart.

If recovery is not complete in a short time the transfusion should be given up, and the patient put to bed in a head-up posture, given carefully graded doses of nitroglycerin to insure peripheral dilatation of the vessels, and digitalin hypodermically *in very small doses* to stimulate the heart muscle directly. Small does of morphin may also be given if needed, but it must be remembered that the recipient has had 1/4 of a grain before the transfusion. Absolute rest and quiet and a reduction of the amount of fluids ingested are also requisite. Such a patient needs careful watching with treatment of the symptoms as they arise.

The treatment of shock and of acute hemorrhage by transfusion is primarily mechanical in its nature, and need not be discussed further here under the general considerations. The treatment of all other conditions, however, is a question of therapeutics when reduced to its final analysis. The surgeon takes the place of the internist when he gives a "dose" of blood.

In the therapeutics of transfusion there is a possible danger to be considered. In certain diseases, when similar bloods are intermingled (*i. e.,* blood from animals of the same species), what is ordinarily designated as "hemolysis" occasionally occurs. Agglutination of the red corpuscles and precipitation may also occur, but, from a practical standpoint at least, the author has had no reason to believe that these two last changes may be regarded as possible sources of danger.

The mistake must not be made of considering "hemolysis" as destruction of the red corpuscles alone. It would be more appropriate to say that "hemolysis" is a toxic condition which gains its name from the fact that the red corpuscles are destroyed to a greater or less extent, but that *one* of the *effects* is not the cause. Hemolytic destruction of red corpuscles is one matter, but toxemia is another. The serum of the pathologic blood may act as a poison and incidentally destroy certain of the red corpuscles. When the amount is large, appreciable changes probably take place in the parenchymatous organs such as occur when dissimilar blood is transfused. It is a question as to whether the interaction of similar serum on the red corpuscles and on the other organs does not cause the formation of new toxic substances which was previously present in neither—*i. e.,* that it is more than the poisonous action of the serum alone which must be held responsible. Moreover, may not a possible rôle of the leucocytes be overlooked when the red cells alone are considered ?

The pathologic changes which follow injection of dissimilar blood have been studied by *Hasse* and his followers and others. The extent of the lesions varies considerably for a given animal, according to the species from which the blood is taken, serum from one species being more toxic than that from another; but the extent varies still more with the *amount* of blood transfused. It seems reasonable that there should be a direct ratio between the dosage and the effect produced, just as there is in giving a drug. While a small amount of a given enzyme will hydrolyze a disproportionately large amount of organic substance without losing its powers, there is no evidence of any similar action occurring between toxic serum and the blood or other cells of the recipient.

From the above it may be deduced that the question of dosage may be very important, especially when there is hemolysis of the recipient's red corpuscles by the donor's serum. Therefore, in all but emergency cases preliminary hemolysis tests should be made in order to handle a given transfusion more intelligently and protect the recipient more fully. The technic to be followed in making these tests is described in a following chapter.

The author has had but one case in which serious hemolysis occurred. The patient had an inoperable suppurating carcinoma of the groin, and was transfused on three separate occasions from five different donors. The hemolysis began to appear on the second day after the third transfusion (from two donors). Death occurred ten days after this transfusion. After the previous transfusions there had been no gross evidences of hemolysis, although no tests were made to determine whether any hemolysis occurred or not. The question is whether death was due to hemolysis in the broader and more correct sense (*i. e.,* from toxemia), whether hemolysis would have occurred if the two donors had been used on separate occasions instead of one immediately after the other, whether transfusion from either of the donors alone would have caused hemolysis, and whether death was due to hemolysis (toxemia) caused by the action of the cancer element in the serum on the blood from the donor.

It is impossible to say whether death occurred from hemolysis (toxemia from the transfused serum) alone or from a combination of causes. The patient was more or less septic from the presence of infection in the ulcerated cavity in the groin. He had had a long and severe illness, the bleeding before the transfusion was unusually severe, and while the blood lost was more than replaced it was a severe test of his strength and endurance. The cancer was hopelessly inoperable and had progressed well along toward the terminal stage. There had been no appreciable hemolysis after the other transfusions, and in several other cases patients had received blood from different donors without its occurring. It is known that cancer serum will hemolyze red corpuscles, and the hemolysis may simply have been due to the complete destruction of the corpuscles from the donor (the patient's blood must have been very largely substituted by the transfused blood) without toxin formation which would affect any of the patient's cells (they were already more or less immune to the toxin liberated from the cancer). On the other hand, in patients in the last stages of cancer the author has found that a "reverse hemolysis" occasionally occurs—*i. e.,* that the red cells from the cancer patient are hemolyzed by normal serum. That death was not due to asphyxia from destruction of the red corpuscles was shown by the fact that there were no symptoms before death which suggested asphyxia. The probability is that death was really due to a combination of factors which cannot be separated to estimate the exact influence of each. This case suggested the hemolysis test for cancer.

If it is found by the preliminary tests that the red corpuscles of the recipient are hemolyzed by the serum of the would-be donor, the advisability of transfusion should be carefully considered. This does not necessarily indicate that the blood of the donor is at fault, but rather that the recipient is in such a condition that any blood would be toxic to him when introduced into his circulation. In all cases which the author has had there has been no evidence that the blood of the donor was ever at fault. Therefore it is improbable that it would avail in such a situation as the above to try to use another donor. This is not meant to convey the impression that the blood of the donor may never be harmful in itself—in time donors may be found to whom the causation of harm may be traced. So far, however, this has not been done. On the other hand, if the serum of the recipient hemolyzes the red corpuscles of the donor, it does not necessarily mean that another donor should be chosen. It all depends on whether the effective principle or principles of the serum are altered at the same time that the red corpuscles are destroyed.

Following a successful transfusion certain phenomena almost always occur. The stimulating effects of the new blood may be very marked. A poor surgical risk may be made a good one, the delirium of extreme hemorrhage or of toxemia may be replaced by a return to normal mental conditions, or the wrinkled, aged face of prolonged hemorrhage may be restored to its normal aspect and the years apparently fall away under the very eyes of the observer.

A chill of greater or less severity followed by a corresponding febrile reaction is to be expected, and usually occurs. Former writers have often commented on this phenomenon. It is not necessarily an indication of hemolysis, although a violent chill is apt to follow transfusion of dissimilar blood. Ordinarily it apparently has no more significance than the chill which frequently follows the infusion of saline solution. In this connection it is of interest to note the observations of *Debove* and *Bruhl,* who found after giving saline infusion a rise of temperature of 1.5° C. (2.7° F.) in 19, 1° C. (1.8° F.) in 31, and 0.5° C. (0.9° F.) in 45 out of 95 cases.

The heart action is strengthened, the pulse becomes regular, slower, of higher tension and better volume, and the respirations slower and less shallow. In a hemorrhage case the change in the due of the skin and mucous membranes may be very marked, while the red cells and hemoglobin increase in proportion as shown by the red counts. In a certain number of cases the recipient has vomited a small amount of watery, grayish material. The actual case histories, however, should be consulted for the account of the changes occurring in the individual cases.

As with the donors, the question arises as to how much blood should be transfused. The condition of the donor and the recipient and the purpose of the transfusion enter into this. Here again very much depends on the judgment of the surgeon. No definite rules can be given. Enough blood must be transfused to accomplish as much as possible, and yet too much must not be given. Sometimes in cases where the patient does not suffer from the loss of a large amount of blood it seems to be as advantageous to transfuse small as large amounts. The symptoms of the recipient give the best key to the situation.

Crile regards the direct transfusion of blood as an exceedingly valuable measure in the treatment of the problem of exsanguination. Whatever varied conception may be permissible from a biologic or chemical viewpoint, it is fair to state that *Crile's* work is entitled to serious consideration. The writer's conception in this regard is expressed by the extensive quotation placed in this volume.

It is to be borne in mind, however, that the technic of the procedure is not readily mastered, and that, if the measure is undertaken for hemorrhage, delay or a possible failure are objectionable occurrences in this class of cases. As far as shock from injury of magnitude, due to accidental trauma or prolonged manipulation of important organs during an operation, is concerned, the writer feels that the objections which may be brought to bear against direct transfusion do not apply with equal force to infusion with saline solution.

In operating in well-equipped hospitals, the direct transfusion of blood has, perhaps, a distinct field of usefulness, especially if the necessary preparation is made in view of the character of operation which is to be performed.

In private practice and, indeed, in the practice of surgeons who operate under less favorable conditions in this regard, the measure will not be found quite as serviceable. Especially is this true of the practitioner who does emergency surgery, as obtains in the less populated areas, the class of professional man this work is expected to serve most.

INFUSION

The infusion into the circulation of solutions destined to increase blood pressure is made either into a blood vessel sectioned at the site of the operation, or into one remotely situated in some other portion of the body. The latter course is preferable, and in either case the injection is made toward the heart. If the infusion is made during the course of the operation, a vessel

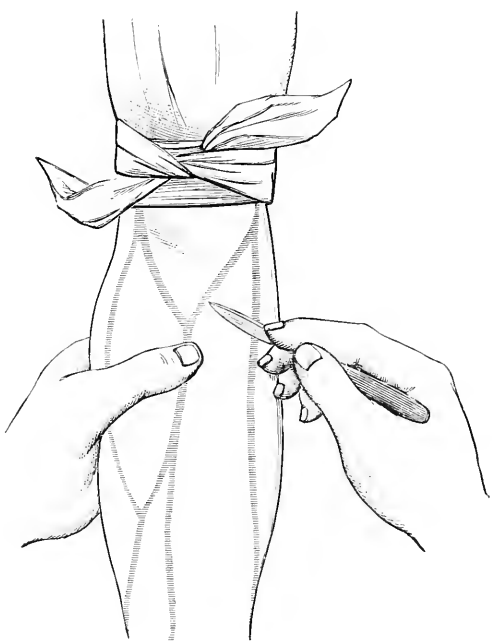


Fig. 204.—Opening the Vein with Scalpel. (*Bryant.*)

opening into the wound may be employed. As a rule, the infusion is best made into the vein at the bend of the elbow.

The instruments required for the purpose are shown in Fig. 205. The various kinds of cannulæ are all useful. However, in

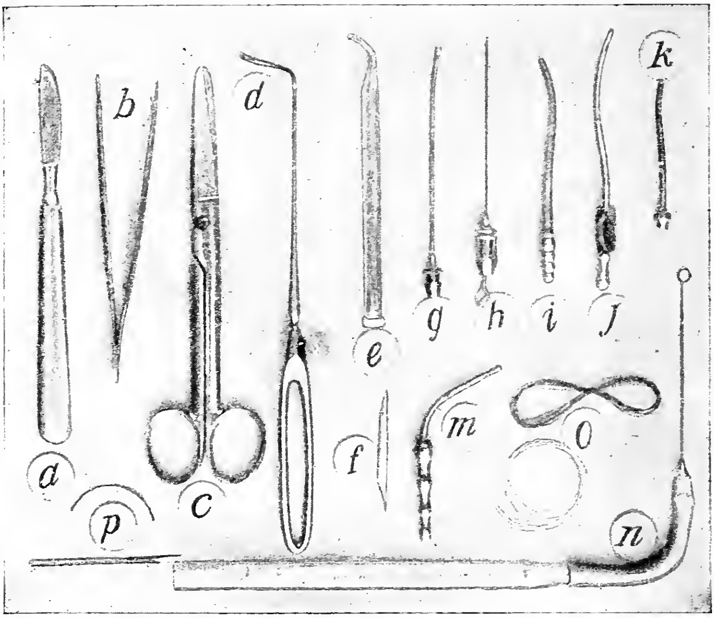


FIG. 205.—INSTRUMENTS EMPLOYED IN THE OPERATION OF INFUSION. *a*, Scalpel. *b*, Thumb forceps. *c*, Scissors. *d*, Aneurism needle. *e*, Ordinary dropper with curved point, extemporaneous cannula. *f*, Toothpick for same purpose. *g*, *Cooper's* cannula. *h*, *Kelly's* needle. *i*, *Luckett's* cannula. *j*. *Fowler's*. *m*, *Harris's* cannula. *n*, *Fowler's* thermometer for cannula. *o*, Catgut and silk-worm gut. *p*, Needles. (*Bryant*.)

case of emergency a curved glass eye dropper admirably fills the requirements. The reservoir holding the solution may consist of a simple fountain syringe or, if available, one of the apparatuses shown in Fig. 206 may be used. Glass receptacles have the advantage of permitting scrutiny of a thermometer submerged in the liquid without manipulation. This is, however, not essential. Indeed, in operations done in private residences too much apparatus becomes cumbersome, and, as a matter of fact, a glass eye-dropper and a sterile fountain syringe are all that are necessary to accomplish the purpose. The receptacle should hang about three feet above the level of the vein. The technic of the procedure is simple, a bandage is tightly placed about the limb central to the vein to be opened, and the vessel exposed by a transverse incision (Fig. 204). The object of the central compression is to make prominent the vein and render identification more easy. However, in profound shock only little

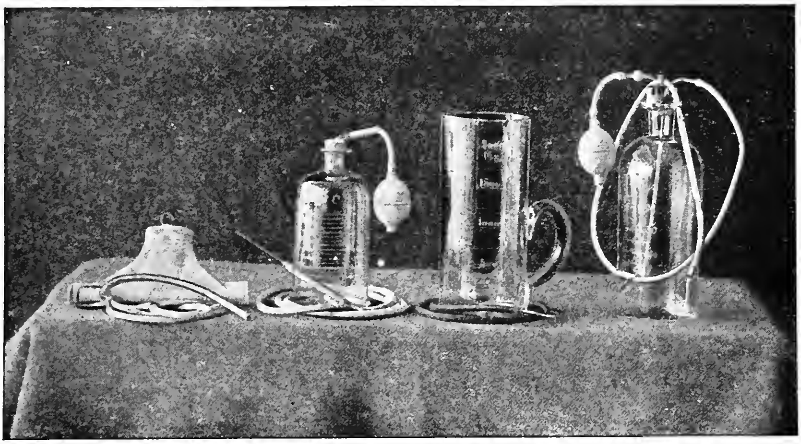


FIG. 206.—APPARATUS FOR INFUSION. Ordinary fountain syringe. *Kelly's* apparatus. Graduated glass reservoir and infusion tube. *Fowler's* apparatus with thermometer attached. (*Bryant.*)

will be achieved as the result, for obvious reasons. After cleansing of the skin the vein is exposed as stated, and after isolating it from the surrounding tissues a catgut ligature is passed round the vessel and left untied. Care must be taken not to puncture the vein at this time. The vein is now ligatured by a second catgut ligature placed distally. The vein is opened by a transverse incision made through one-half its circumference with scissors (Fig. 207), and the cannula is introduced, permitting the fluid to flow as the anastomosis is being made, to obviate the entrance of air into the circulation. The loose ligature is now tied with a half knot about the inserted cannula and the fluid allowed to enter. After the infusion is completed, the cannula is withdrawn and the encircling ligature firmly tied by completing the knot, and the superficial wound is approximated with one or two sutures and dressed in the usual way. The temperature of the fluid should be about 118° F. Various mixtures consisting of the inorganic constituents of the blood in solution have been employed for the purpose. However, a solution composed of six parts of sterile table salt to one thousand parts of filtered sterile water fully answers the purpose. This corresponds practically to a heaped teaspoonful of salt to a quart of water.

The dosage of fluid administered should be between one pint

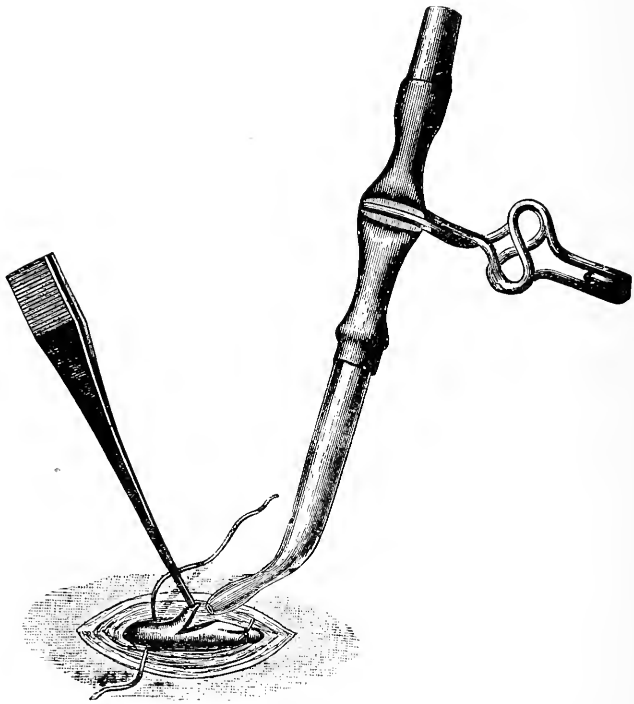


Fig. 207.—Introducing the Tube in Infusion. (*Bryant.*)

and a quart, according to the indications, given very slowly. A quart of solution should be injected in about half an hour, as too rapid instillation is likely to cause edema of the lungs and thus increase embarrassment to the circulation. The salt should, if feasible, be chemically pure, for obvious reasons, and the concentrated solution described (page 81) is recommended for use.

A formula much employed in hospitals is added.

℞ Sterilized and filtered water......32 oz.
Sodium chlorid (c. p.)..........$1\frac{1}{2}$ drms.
Sodium carbonate (c. p.).........15 grs.

M. Heat to 112° F.

In large institutions where facilities for sterilization are conveniently at hand, this solution is made and kept in stock to be heated at each operation.

To the salt solution adrenalin chlorid solution may be added. Its prompt action when administered in this way recommends its use. A teaspoonful of the adrenalin solution on the market added to a quart of saline solution gives the proper proportion of dilution. The adrenalin may be added to the salt solution when administered under the skin or introduced into the lower bowel.

NEEDLING OF ARTERY

Dawbarn in urgent cases employs a method called "needling." The solution prepared as above is placed in a receptacle, which, however, must be elevated to the height of six feet above the patient, or a *Davidson* syringe is used to inject the fluid. The needle of an ordinary hypodermic syringe of large caliber is pushed into the radial or femoral artery, according to which is the most available, and the fluid is permitted to enter through a rubber tube connection. This method is useful, but is only applicable in cases of emergency, and should be used only by the surgeon who has confidence in his tactile sense. As a rule, the eye is more trustworthy than the sense of touch, and the intravenous infusion had best be employed unless, indeed, the conditions warrant indulgence in the more intricate manipulation. If the needle does not enter the lumen of the vessel, it will be seen to distend the surrounding tissues. This is not objectionable, as will be seen later. The needle must be withdrawn and re-entered if this happens. Accidental introduction of air will not occur if the fountain syringe be used. However, this is liable to happen if a *Davidson* syringe be employed for the purpose. Again, the fluid in the syringe is liable to cool rapidly, but both the too rapid cooling of the fluid and the entrance of air may be avoided by submerging the syringe in a hot solution of salt while making the injection.

HYPODERMOCLYSIS

Hypodermoclysis consists of the injection subcutaneously of the solution stated. Adrenalin may be added to the solution in the same way as when the agent is used in intravenous infusion. The method is not of distinct service in shock from loss of blood, except inasmuch as it contains the adrenalin. Absorption from beneath the skin is necessarily slow, and, indeed, it is a question

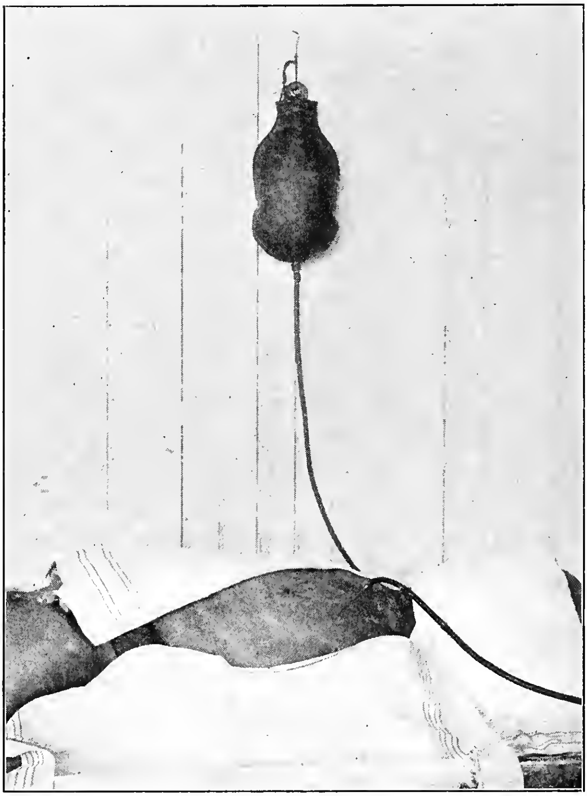


Fig. 208.—Hypodermoclysis.

if it be as rapid as obtains from the colon. As a whole, it seems fair to say that it is the less frequently indicated of the three methods of introducing saline solution. The solution is placed in any one of the containers mentioned, which is connected with a large-sized needle, and the skin, after being cleansed, is punctured, and the fluid slowly permitted to enter. The pectoral region, the buttocks, and the lastimus dorsi are favorite sites of injection. No more than half a pint should be introduced in one place. The skin will be found quite tense as the outcome of the entrance of this quantity, and the injection of a greater amount may lead to pressure necrosis of the surrounding soft parts. Indeed, this possibility, even with proper precautions, is sufficiently liable to occur to constitute an objection to the method. When it is borne in mind that circulation is necessary to absorption, it is easy to see how the fluid may remain in the region of its introduction without entering the circulating fluid for a considerable period of time. In cases of moderate shock not attended with loss of blood the method may be used. But if the intent of the act be to furnish a circulating medium to a depleted peripheral circulation, the measure may be said to fail to accomplish the purpose. Fig. 208 shows the method being employed in the region of the pectoral muscle. The needle is usually steadied by the hand. The temperature of the fluid should be about 110° F. At times a half hour is expended in making the injection. Massage of the parts immediately subsequent to the injection favors absorption of the fluid.

ENTEROCLYSIS

Enteroclysis means the introduction of saline solution into the lower bowel. Its rationale as regards absorption lies in the assumption that the blood is more largely collected in the vessels of the abdomen, and that, because of this, it will readily take up the fluid. Enteroclysis probably occupies a position between venous infusion and injection into the subcutaneous tissue. In a general way, profound shock calls for venous infusion, less severe shock for enteroclysis, and moderate shock without loss of blood for hypodermoclysis.

As a rule, the lower bowel is thoroughly emptied before an operation is begun, making a preliminary cleansing enema unnecessary. However, if there be any doubt in this connection, the enema should be given.

The solution employed is, in every respect, similar to the one used for intravenous infusion, except that the quantity which may be projected into the bowel may be much greater. Indeed, it is not uncommonly possible to introduce a gallon of the fluid into the colon, especially if the procedure be slowly accomplished. The first pint of the solution may be more rapidly introduced, but, after that, the bowel is less likely to rebel and eject the fluid if the rest of the solution be permitted to flow into the colon slowly. At the beginning of the injection the container may be elevated to the height of three feet above the patient, but after a pint has flowed into the bowel the irrigator should be lowered a full foot. At no time should the pressure be made greater than obtains from three feet of elevation of the container.

The solution need not necessarily be absolutely sterile, though this is desirable, but if it be given by persons not familiar with the technic of asepsis, this method is vastly superior to the former two, as, of course, these require rigid asepsis.

The patient is placed on the left side and the foot of the bed elevated to promote gravity (Fig. 209); a rectal tube (Fig. 82)

Fig. 209.—Administration of Saline Solution into Rectum.

is carefully passed through the anus and on into the sigmoid and connected with the rubber tube of the receptacle by means of a glass tube. The fluid is then allowed to flow as stated. Adrenalin or other remedial agents may be added to the solution. Indeed, if a previous history of alcoholism be obtained, the bromids, etc., may be given at the same time. In the case of much nervous irritation preceding the operation, the writer frequently adds bromid and chloral to the enema with the view of obviating the necessity for the use of opiates. These, however, are not to be employed in cases where their depressing effect upon the circulation is a consideration of importance.

In this connection attention may be called to the beneficial effect produced by enteroclysis with large quantities of fluid for the relief of thirst following postoperative vomiting. This will, however, be more largely taken up later (page 283).

If the bowel shows evidence of irritation and rebellion during the administration, the enema must be arrested. In these cases it is best to give a pint of the fluid every hour or two, though if a larger quantity is retained, the manipulation need not be repeated more frequently than at intervals of four to six hours.

SECONDARY HEMORRHAGE FOLLOWING OPERATIONS

Bleeding does not occur during profound shock. This is easy to understand when the mechanism of shock is borne in mind, and applies with greater force to shock from loss of blood, which requires no stretch of the imagination to be regarded as a conservatism on the part of nature. Shock from loss of blood and spontaneous arrest of hemorrhage is not necessarily the outcome of fatal exsanguination. The circulatory apparatus conforms relatively to the quantity of blood it contains. If this be lessened shock occurs and the bleeding is temporarily stilled.

The indiscriminate use of stimulants following severe operations if large areas have been attacked favors the occurrence of secondary hemorrhage. If all divided blood-vessels have been secured, stimulants may be given. Nothing which raises the blood-pressure should be administered if bleeding is going on. This admonition applies especially to adrenalin chlorid. The routine practice of giving every case stimulants as it comes off the table is to be deprecated for the reasons stated.

Secondary bleeding occurs simultaneously with reaction from shock. It varies in extent with the degree of the shock and the quantity of blood lost. The picture presented by secondary hemorrhage is practically that of shock with thirst and dyspnea added. Sudden increase of pulse rate, restlessness, lowering of body temperature, and thirst are indicative of bleeding. If the operation has involved a cavity which is subsequently closed, these manifestations justify measures directed to the relief of secondary bleeding. If the bleeding come from a superficial wound, the condition of the protective dressing will, of course, indicate the bleeding before systemic manifestations present.

The indications for treatment are clear. The first step is to arrest the bleeding. The patient is narcotized and the bleeding arrested in the usual way. Chloroform, while a less safe agent in itself, should be used for the purpose, as ether raises blood-pressure. The administration of the chloroform should be carefully executed, and profound narcosis avoided if a certain muscular resistance on part of the patient does not defeat the object. When the bleeding points are controlled, adrenalin chlorid may be given hypodermatically, and the field watched for recurrence of the bleeding. Hemorrhage from the arteries and veins is easily controlled.

Parenchymatous oozing and capillary bleeding if not arrested with hot applications call for tamponade. The use of astringents is to be avoided.

THE MIKULICZ TAMPON

For the purpose the *Mikulicz* tampon is exceedingly effective. The tampon is introduced with its apex in the bottom of the wound, and the cavity filled with strips of gauze (Fig. 210). The gauze tampon should have its edges turned in to obviate unraveling, and consists of four layers of gauze (Fig. 211).

At the same time sutures may be introduced into the wound, as shown in Fig. 223, to be tied when the tampon is removed. When the hemorrhage is arrested, stimulants may be given and the case treated as described under shock.

REMOVAL OF MIKULICZ TAMPON

The *Mikulicz* tampon should remain *in situ* for forty-eight hours. At the end of this time the gauze strips are moistened with a hot antiseptic or aseptic solution, in the manner described under dressing of wounds. The object of having the tampon

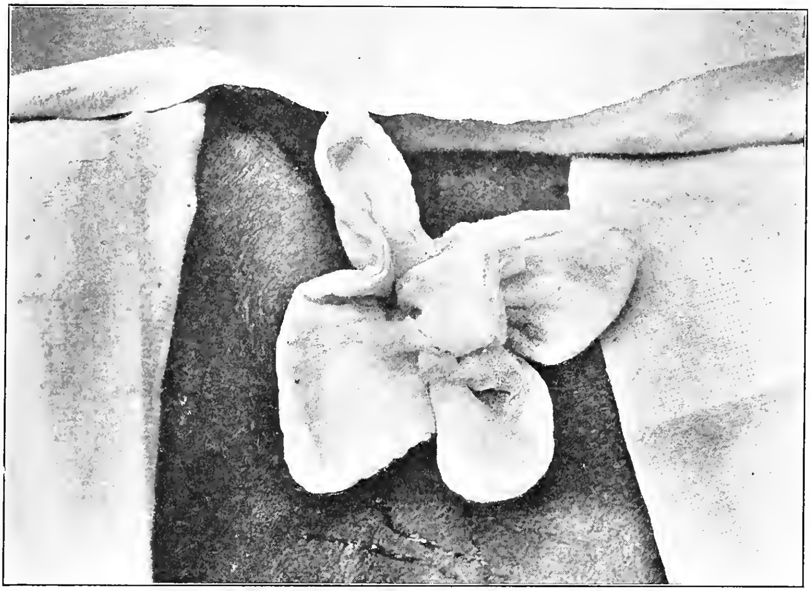


Fig. 210.—*Mikulicz* Tampon *in situ*. Gauze square filled with strips of gauze.

square in contact with the wound surface is to permit of removal of the bulk of the pressure agent without disturbance of the surface of the wound. The tampon square is, of course, adherent

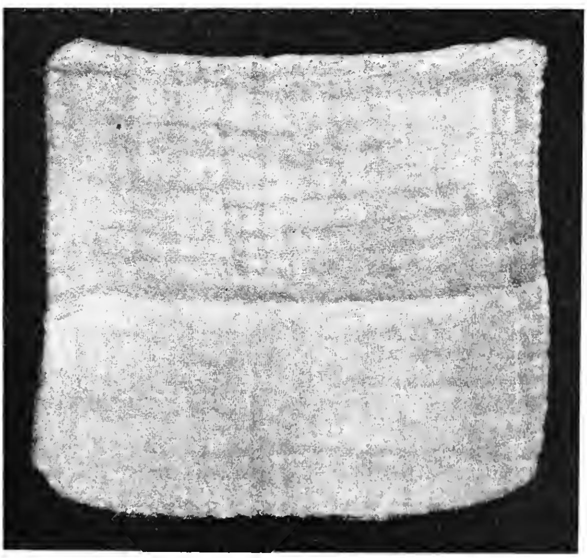


Fig. 211.—*Mikulicz* Tampon. Gauze fashioned into square with edges turned in.

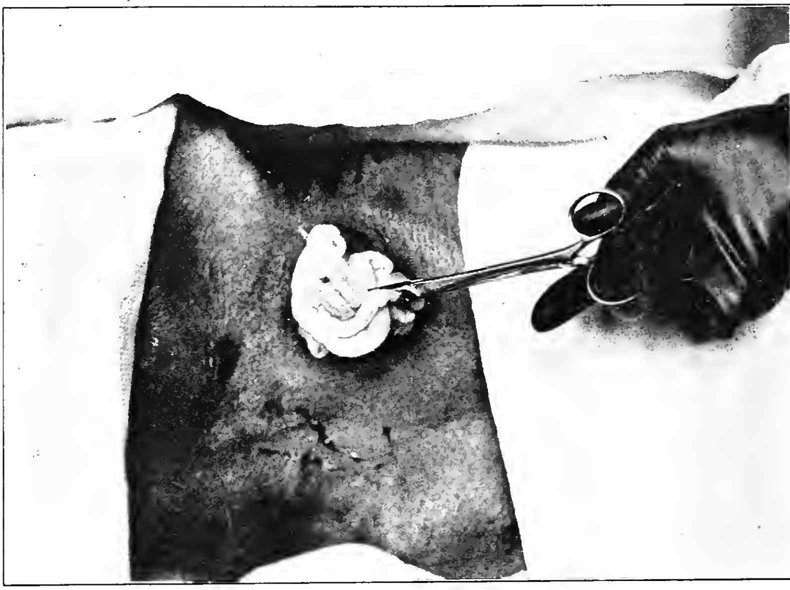


Fig. 212.—*Mikulicz* Tampon Grasped with Heavy Hysterectomy Forceps Ready for Removal.

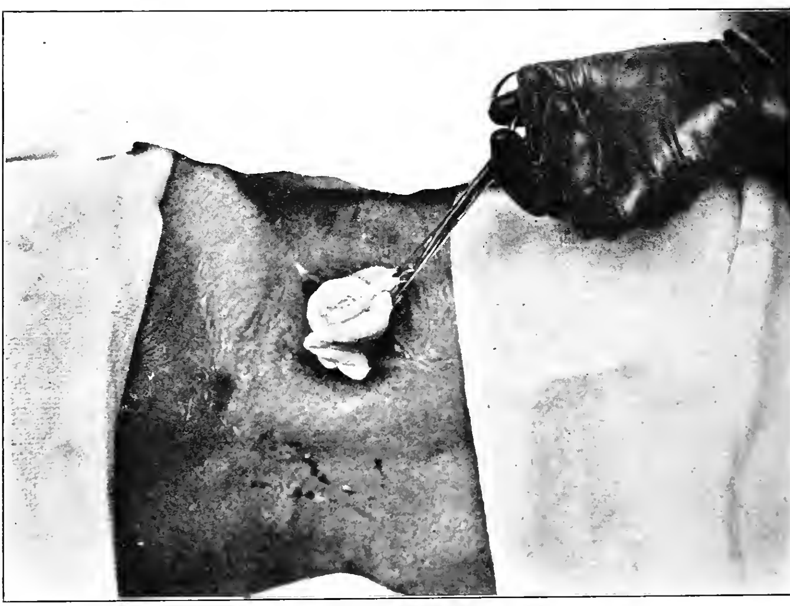


Fig. 213.—*Mikulicz* Tampon Twisted and Loosened from Sides of Wound, Ready to be Lifted Out.

to the contiguous raw surfaces, and its removal is likely to be attended with trauma to the small vessels, which have been obstructed by coagulated blood, and when these clots are torn away as the tampon is removed renewed hemorrhage may occur. After the gauze strips have been withdrawn, hydrogen peroxid is syringed beneath the edge of the square of gauze, and after the more externally located portions are thus loosened, the protruding part is folded together and held in a clamp (Fig. 212) and slowly and carefully twisted (Fig. 213), at the same time continuing the injection of hydrogen peroxid until the tampon is finally lifted from its seat.

The solutions used for the purpose should be hot (110° F.) with the view of arresting whatever oozing may occur. The wound may now be closed with stitches previously introduced (Fig. 223), or be left open as the conditions presented indicate.

CHAPTER XII

VOMITING AND ACUTE DILATATION OF STOMACH AND GUT

Postoperative vomiting: Character of vomited matter—Acute dilatation of the stomach and gut: Treatment.

POSTOPERATIVE VOMITING

The postoperative care of patients varies in certain regards with the character of affliction for which the operative relief has been employed, and these variations will be taken up in connection with the various classes of operations. There are, however, certain general considerations which apply with but little modification to all cases. The factor which enters most largely into consideration of vomiting after operations is the outcome of anesthesia produced by narcotics. The prophylaxis involved in this proposition with regard to restrictions of diet, catharsis, etc., has already been discussed under the head of preparation of the patient (page 38). Beyond this, however, various medicinal agents have at intervals been more or less actively exploited, which, when administered before the operation, are believed to have a beneficial effect in this connection. It is probable that none of these is effective in all cases, and that some have no influence in any. This subject is taken up to a considerable extent in dissertations upon narcosis generally, and does not call for detailed consideration here.

It is to be borne in mind that the gastrointestinal canal is an important eliminative organ when toxic substances are present in the blood, and it is, of course, certain that the physiological effect of narcotics is the outcome of a poisoning of the circulating fluid which is in no small degree similar to toxemia from other causes. The vomiting following administration of narcotics by inhalation may be regarded as physiological, though, indeed, the major portion of the offending substance is thrown off by the lungs, kidneys, and skin. The fact that vomiting after operations is not in any sense dependent solely upon the operation, is shown in instances where narcosis is produced for the purpose of making accurate physical examinations. In these instances vomiting follows in as large a number of cases as obtains when operations have been done, although, be it also said, the length of time or the quantity of narcotic given bears a direct proportion to the severity of the vomiting.

Perhaps the measure which is most largely employed is the administration hypodermically of one-quarter of a grain of morphia and one-one hundredth of a grain of atropia one hour before the operation. This measure has been universally used by surgeons, and if not always effective with regard to the control of vomiting, has some additional advantages which make justifiable its employment.

In the vast majority of instances the mental status of a patient about to be subjected to surgical operation is apprehensive, and the small dose of morphia mentioned creates a certain complacency of mind which is not objectionable. The atropin is also slightly stimulating, and its effect upon the salivary secretions is beneficial, as it lessens the quantity of saliva and mucous secretion in the mouth and in a measure prevents excessive collection of fluids in the air passages during the narcosis. On general principles, it is difficult to see how morphia, which paralyzes involuntary muscular fibers and lessens secretions generally, can in any way hasten elimination of the narcotic employed. Indeed, the contrary is to be expected, yet it would seem that vomiting does not occur as largely in instances where this mixture of morphia and atropia has been given. The writer does not employ medicinal agents before operations with the notion of controlling vomiting, for the reasons stated, though in especial cases and for special indications the mixture mentioned is in a certain number of cases employed.

In a few instances postoperative vomiting is maintained for many hours, and, indeed, for days after operation. This will, however, be found to be the result of the character of operation, the coexistence of nephritis, or due to a toxemia other than the effect of the narcotic. In every case in which vomiting persists for more than several hours following an operation these factors must be considered. Few agents remain in the circulation for many hours after administration, and when it is remembered that narcotics enter the circulation through the respiratory tract, and are not gradually absorbed from the stomach, as is the case when medicinal agents are administered, the rationale of this statement seems clear. This means that toxemia due to substances in the stomach, or one which is the outcome of an available reservoir in the form of an area of inflammation, presents the picture of a disturbed balance between absorption and elimination, while the source of supply is immediately withdrawn when no more narcotic is administered, and last it is worthy of note that narcotics are, because of their chemical and physical characteristics, very rapidly thrown off.

Assuming that the stomach is concerned in eliminating these agents, it is not difficult to conceive of a mixture of mucus and secretion in the stomach, which holds the end products of the narcotic in solution or in suspension, and that a liberal evacuation of this is desirable. In order to accomplish this, many surgeons administer a pint of warm saline solution to patients as soon after the operation as deglutition is possible, and regard the resultant evacuation of the stomach as eliminative and, perhaps, less offensive and objectionable than gastric lavage at this time. Also, for the same reasons, lavage of the stomach is done at times on the operating table while the patient is still narcotized. However, it is to be remembered that the actual indication for this measure does not occur until the stomach has been for several hours concerned in eliminating the narcotic, and that perhaps the only benefit which immediate lavage may accomplish is removal of the contents accumulated during the operation, and perhaps, too, it may be regarded as preparing the gastric mucosa better for its impending labor. Following operations upon the upper air passages, in which instances blood and secretions are inadvertently swallowed by the patient, an especial indication for immediate gastric lavage is presented, and the measure is properly employed at this time.

While the stomach is concerned in this eliminative function it is quite incapable of converting nutritive substances into absorbable material ready for entrance into the circulating fluid, and, therefore, the introduction of articles of diet during the first few hours immediately following the operation is contraindicated. Indeed, these substances when introduced accumulate in the stomach and act as a foreign body, which increases the irritation of the gastric mucosa already present as the outcome of its eliminative efforts, and prolongs vomiting. For this reason it is the rule to rest the stomach completely as regards digestive efforts for twelve hours after the operation. This does not mean that the narcotic is not eliminated before the expiration of the twelve hours, but that, unless lavage or vomiting has cleansed the stomach, the condition of the mucosa is such as to render normal function of the organ quite impossible.

The causative factors which enter into gastric disturbances following operations do not relate alone to the narcosis. Indeed, it may be said that, while this is an important consideration, its consequences are most largely questions of comfort and expediency in recovery. The fatal disturbances of the stomach which are at times attributed to the carelessness of the nurse or attendant in administering food or medication immediately after an operation are the outcome of much graver influences than this.

It is, of course, best not to permit of the administration of any food for the time stated. Yet, the introduction of small quantities of hot water, a teaspoonful every fifteen minutes, is not objectionable, and acts as a diluent to the offensive material in the stomach and, indeed, in its passage over the pharyngeal and esophageal mucosa is exceedingly grateful to the patient. The water is, of course, not destined to relieve thirst by its local action, as thirst is a local manifestation of the systemic need for fluids. However, it has a certain place in this connection and may be used. It may also be replaced with cold water or cracked ice used in the same proportions, if there be no contraindication. This is, however, largely a matter of the patient's taste, as the temperature of either is about the same at the end of the six seconds required for deglutition. Thirst as a postoperative occurrence is taken up under a separate head (page 283).

Summarizing the situation as so far presented, it is fair to say that if vomiting be a manifestly obtrusive symptom at the end of several hours after operation, a pint of warm saline solution may be given, and if this be ineffectual in controlling the vomiting, gastric lavage may be employed. In any event, the various medicinal agents which are quite generally regarded as capable of affording relief are best omitted. Rest, as far as the digestive function of the stomach is concerned, is the wisest plan to pursue. A direct local effect from these agents upon the gastric mucosa is difficult to understand, and if the action of the agent be regarded as the outcome of entrance into the circulation, and general effect is designed, the hypodermic method and the lower bowel present far more favorable avenues of approach than is obtained as the outcome of deglutition.

The introduction of medicinal and nutritive agents into the rectum is taken up under a separate head (page 291).

CHARACTER OF VOMITED MATTER

This, aside from the indications it gives of diagnostic value, is of great prognostic import, and in every case the nurse or attendant must be instructed to preserve the vomit for inspection, and, indeed, in some instances microscopical examination should be employed to clear up doubtful conclusions in this connection. Neglect of this precaution may result in a fatal outcome which perhaps might have been avoided.

The presence of even minute particles of blood, as shown by small dark streaks in the vomit, always arouses alarm. If the vomiting is repeated, and there be an increased quantity of the suspicious color, the case may be regarded as either one of dilatation of the stomach or a beginning sepsis. The former is most likely to occur within twenty-four or thirty-six hours following the operation, and calls for appropriate treatment at once. When the vomit is due to sepsis, it does not usually occur until after the second day following the operation, unless already an overwhelming sepsis has existed at the time of the operation.

In the latter event, the evidence of sepsis will be manifest at the time, and the vomit of blood will not be likely to cause confusion as to its origin. Following abdominal operations for the relief of infective processes, such as pyosalpinx, suppurative cholecystitis, or appendicitis with abscess, the appearance of blood in the vomit may readily be regarded as evidence of systemic invasion of the septic process, the outcome of liberation of infectious material into the contiguous peritoneum.

However, in a certain number of cases the bloody vomit is the outcome of an acute dilatation of the stomach and gut due to either shock, the narcotic, or the mauling of the abdominal organs during the surgical manipulations. Especially is this true with respect to attack upon the gall-bladder. In these cases, the position of the patient making more accessible the operative field, the interference with respiration, the outcome of delivery of the liver into the wound, contributes not a little to the general disturbance, resulting not infrequently in acute dilatation of the stomach and gut. Indeed, in this class of cases the stomach itself is handled to a greater or lesser extent, depending upon whether the common duct is attacked, and the trauma to the pylorus contributes a not unimportant part to the outcome. The condition is more frequently a postoperative complication following abdominal operations than after operations in other portions of the body, a fact which would tend to show a certain causative relationship in the connection mentioned.

ACUTE DILATATION OF THE STOMACH AND GUT

Acute dilatation of the stomach and gut occurs with sufficient frequency after operations to warrant consideration here.

The condition, is perhaps well represented in the history of the case here described.

Mrs. A. H., subjected to Cesarean section. Pelvis filled with immovable mass, which proved upon celiotomy to be a large dermoid cyst. Hysterotomy and delivery of fetus readily accomplished in the usual manner. Operation done with considerable rapidity was not attended with evidence of shock of sufficient import to call for the use of particular precautionary measures. At end of twenty-two hours the patient expressed herself as feeling comfortable. Temperature in rectum 100° F., pulse 115. Vomited at this time four ounces of clear fluid slightly streaked with blood. Patient, however, was not permitted to partake of nourishment by mouth. Saline irrigation of colon ordered.

At the time of the operation no evidence of infection had been manifest, and it was considered improbable that infection had been introduced at the time of the operation. The presence of blood in the vomit was regarded as accidental and possibly the outcome of the rupture of a small vessel in the esophagus. However, the increase of pulse rate disproportionate to the accompanying symptoms was regarded as suspicious. It was difficult to conceive of a sepsis so overwhelming as to cause venous stasis and hemorrhage into the stomach after the lapse of a bare twenty-four hours following the operation. Six hours later the patient vomited a pint of dark brown fluid, which upon microscopical examination proved to consist largely of blood. The pulse rate had not been accelerated at this time, being still 110 to 115 per minute. The temperature had risen to 101° F., which excluded delayed shock. The patient at this time expressed herself as feeling comfortable and asked for food.

The clinical picture was confusing. Sepsis was regarded as exceedingly improbable, and in view of the absence of symptoms other than the bloody vomit, after consultation with *Dr. L. K. Neff,* it was decided to ask *Dr. Robert Coleman Kemp* to see the case with the view of washing out the stomach, and to obtain the benefit of his advice. Several hours later, when *Dr. Kemp* saw the case (thirty hours after the operation), the abdomen had become distended, the patient complained of oppression in the epigastrium, dyspnea, and the facial expression was anxious. Temperature, 101° F.; pulse, 120. Examination of the abdomen showed what appeared to be a widely distended stomach, though the tympanitis was not limited to the region of the stomach. It was evident that the intestines were also distended. *Dr. Kemp* made immediate gastric siphonage, drawing off a *gallon* of dark brown fluid. The colon was then irrigated per rectum, the head of the bed elevated, and eserin and strychnia administered hypodermically. Immediately after the gastric siphonage and lavage the distention in the upper segment of the abdomen disappeared. The colic irrigation was attended with expulsion of large quantities of gas and some liquid feces. The distention in the lower portion of the abdomen was not so palpably reduced as had obtained in the region of the stomach.

The patient expressed herself as much relieved, the respirations became tranquil, and the pulse rate diminished to 100 per minute. At the end of another six hours the distention in the upper portion of the abdomen reappeared, though it was less marked than before. The same treatment was employed with the same effect. The colic lavage was made continuous from this time, employing the *Kemp* tube (Fig. 345) for the purpose. The administration of eserin and strychnia was repeated. The symptoms did not reappear after this, and the patient made an uninterrupted recovery, although the pulse rate did not assume normal proportions for several days after the abdominal symptoms had subsided, showing that a serious impression had been made upon the vital processes.

This case may be regarded as typical of acute dilatation of the stomach and intestines following operation in which shock was not a distinct causative factor, although the narcosis may have to be considered as a causative element. It illustrates, too, the necessity for a close scrutiny of the vomit after operations. Had the operation been undertaken for the relief of an intra-abdominal infection, the first appearance of "black vomit" would have been regarded as indicative of an overwhelming sepsis, and an unfavorable prognosis given. Whether the stomach would have been washed out or not at this time would have depended upon the conception the attendant had of the utility of the measure as a matter of routine. The technic of gastric lavage is a simple one. However, its execution is attended with considerable annoyance to the patient and is not to be lightly undertaken, especially as the retching and vomiting attendant upon the measure are undesirable if the operation happens to involve the abdomen. Fear in these cases is felt that the stitches may tear out. The dilatation may be in certain cases limited to the stomach, and lavage or siphonage or both of this organ may meet the indications. However, it is probable that in postoperative cases the dilatation is not limited to the stomach, and an effort should be made to stimulate contraction of the gut by copious colic lavage.

The technic of gastric lavage need not be entered into here. Indeed, the discussion of colic lavage or irrigation is also somewhat out of place in a work of this sort. It is regarded proper by the writer to state that colic lavage is best made with a return tube in these cases, and ample opportunity should be given for the discharge of feces and gas by rectum.

In discussing the problem here, the acute dilatations of the stomach consequent to errors of diet need not be considered, except inasmuch as it should be remembered that probably the administration of food by mouth soon after operations may be regarded as a contributory cause of the condition. The type of cases seen after operation is what *Kemp* calls the mixed type of gastric and intestinal dilatation. If it be true that shock causes a paralysis of the splanchnic and pneumogastric areas, it is easy to understand that dilatation of the gastro-intestinal tract is a logical outcome in certain instances. It is not to be assumed that selective action is restricted to the enervation of the stomach alone in these cases, and, indeed, clinically it is manifest that the intestines are also involved. This means that measures of relief should not be restricted to the stomach alone, as has already been mentioned.

Just how powerfully causative a factor the narcosis is in these cases is not clear. It has been shown that prolonged choloroform or ether narcosis without there having been any operation performed will result in acute dilatation of the stomach.

Whether the causation be that of shock or narcosis or the excessive manipulations of the abdominal contents, is not a matter of great importance for the purpose here considered. In any event, it is certain that the condition is the outcome of a paralysis of the muscular coats of the gastro-intestinal canal, and that, as the result of this, a venous stasis occurs which causes hemorrhagic infiltration and rupture of the capillaries in the mucosa. Blood and serum are poured into the stomach and gut, are vomited in the form of "black vomit," and passed per rectum in the same form. If the condition be not relieved, the picture is one of degree, varying with whether the venous stasis goes on to sloughing and perforation, or if death occurs from toxemia, death from the latter cause occurring in from a few hours to two days following the operation.

TREATMENT

The treatment of the condition is quite indicated in the report of the case mentioned. In addition to this, the shock treatment is to be employed and eserin and strychnia given, the latter to guard the former. Eserin is given in doses of 1-50 to 1-30 of a grain, and strychnia as it is usually used.

Kemp, after cleansing the stomach with water, to a quart of which two ounces of milk of magnesia has been added, puts into the stomach through the tube three to five grains of calomel, together with an ounce of water. The lavage is repeated in two hours. It is best to err on the side of frequency in washing. The fact that the patient does not vomit cannot be regarded as indicative of a favorable condition of affairs. The degree of distention and discomfort is the best indication as to the conditions. Indeed, when the patient vomits, the symptoms are less apt to become alarming, for very obvious reasons. Eserin, together with strychnia, has already been considered. The colic lavage is repeated as often as necessary. Indeed, this measure

FIG. 214.—POSTURAL TREATMENT FOR ACUTE DILATATION OF STOMACH AND INTESTINE, FOLLOWING OPERATION.

has so many allied advantages that it may be used to a considerable extent.

The postural treatment is regarded as exceedingly useful. The patient is postured in a semi-oblique position by raising the head of the bed (Fig. 214). The benefit from this is ascribed to the fact that the abdominal contents are encouraged to gravitate away from the thoracic organs. The posture is, of course, not quite so favorable to the entrance of the colic lavage fluid, but as the intent of this is to facilitate discharge of the intestinal contents, the position may be considered beneficial in this connection. On the whole, the cleansing of the stomach and the colic lavage are the measures which achieve the greatest amount of good.

CHAPTER XIII

THIRST AND PAIN

Thirst: Treatment of thirst—Pain

THIRST

Thirst is one of the most distressing symptoms following severe operations. It bears a quite direct proportion to the quantity of blood lost and the amount of fluids expelled with the vomit. Given a prolonged operation, attended with considerable loss of blood and followed by severe vomiting of irritating fluids, as frequently obtains, and the conditions present a picture which the practitioner often faces, while the operator goes on his way with the complacency born of the belief that he has done a skillful operation. Indeed, it is in these cases that the practitioner is tempted to employ the various medicinal agents already alluded to in connection with postoperative vomiting.

As a rule, the patient bears a different relationship to the practitioner than that which obtains toward the surgeon, and the former is appealed to, and, indeed, often enough pitifully implored to do something to afford relief.

TREATMENT OF THIRST

Opiates, for obvious reasons, increase thirst. The indication is to supply fluids to the circulation. The introduction of fluids into the stomach provokes vomiting and increases thirst. It is in these cases that copious colic lavage is of the greatest service.

The technic of its employment is in all respects similar to that employed in shock. Salt is added to obviate extraction of inorganics from the epithelium of the colic mucosa. When water alone is used, the cells give up their coloring matter, and the inorganics are taken up in solution. Whatever the function of the inorganics may be, they certainly are essential to metabolism, and experimentation shows that osmosis of saline solutions is more rapid than obtains with plain water. It is generally regarded that salt promotes thirst. This may be true under physiological conditions, but for the purpose of obtaining rapid absorption of fluids after operations, it is essential to the intent.

The lips should be frequently moistened with hot water. For this purpose the nurse uses a piece of cotton soaked with hot water, and replaces it frequently with a clean portion. Small doses of hot water, as mentioned in connection with vomiting, may be swallowed at intervals. If the vomit be acid, the burning sensation in the pharynx and mouth may be relieved by allowing the patient to rinse the mouth with a solution of sodium bicarbonate. A small portion of the solution is usually swallowed, and the distress in the esophagus from the same cause is lessened.

If pain be not a marked symptom, opiates should be avoided, as already stated. However, if thirst and restlessness be extreme and not relieved by the measure indicated, morphia should be given hypodermically and in one large dose, *i.e.,* one-half a grain. This will induce sleep and give opportunity for the replacement of the fluids lost.

Many practitioners add atropin to the morphin. This is inadvisable, as the latter agent dries still more the fauces. The repeated administration of small doses of morphia is a procrastination. It should be given in one good-sized dose when the indication for its use is clear. The use of codein is also a subterfuge. The alkaloid of opium which is the most anodyne is morphia, and if this be true, the employment of a substitute alkaloid is unscientific.

It must be remembered that the quantity of urine excreted by patients from whom large quantities of fluids have been withdrawn is largely reduced, and that catheterization is not apt to be necessary for eight to ten hours. If morphia is given, the sense of bladder fullness is likely to be dulled, and this must be taken care of. Patients who require opiates after operations are more likely to require withdrawal of the urine by catheter than if the drug be omitted.

The treatment of severe thirst may be summarized into the administration of a full dose of morphia (gr. ss) hypodermically and the introduction of a large quantity of saline solution into the rectum or colon. The morphia should not be given unless the colic injection is to be made.

The morphia will not enhance the dryness of the buccal mucosa for about fifteen minutes after its administration, during which time a considerable quantity of the saline solution will have been absorbed from the gut. The picture of a restless, thirsty patient, mumbling, dry-lipped for water, is soon replaced by one going to sleep, and the supply of water to the circulating fluid goes quietly on as the patient sleeps. The writer has frequently seen the efficiency of the measure practically demonstrated.

PAIN

The character, degree, and persistence of pain following operations vary, of course, with the kind of operation and the affliction for the relief of which it is undertaken. As a general rule, wound pain is not severe. The reparative hyperemia attendant upon uninfected wounds is not usually sufficiently severe to cause pain.

In a general way the technic of operations should be directed toward the avoidance of postoperative pain. This will be found feasible in a larger number of instances than would appear from a casual analysis of the situation. If the operator would bear in mind, as each stitch is inserted and tied, that just sufficient tension to hold tissues in apposition is all that is necessary to accomplish the purpose, much postoperative pain would be avoided. The objections to tightly drawn sutures have already been mentioned; the warning is sounded again in this connection from an additional viewpoint. Buried apparatus of immobilization should be introduced with the same factors in mind. Indeed, a nail may be driven into bone without the occurrence of subsequent pain, provided the contiguous tissues be so repaired as not to make pressure on the former. The gall-bladder may be attached to the anterior abdominal wall without entailing severe subsequent suffering to the patient, provided the movements of respiration be shown proper consideration in making the anastomosis.

The surgeon is asked to take this into consideration during the operation, as a plea coming from the attendant taking care of the after-treatment. Of course, here again the question of opiates comes up. And, indeed, here again the rule laid down with regard to thirst is to be applied—avoidance of opiates until the indication is clear, and then the administration of a full dose.

The nurse should not be given an order to give a sixth of a grain of morphia hypodermically every two hours until the pain is relieved, but the practitioner had best give the full dose himself, watch its effect, and only repeat it when again the indication is imperative. In the interim measures for the more satisfactory immobilization of the tissues subjected to trauma may be taken.

Under no circumstances should opiates be administered if pain be the outcome of the method in which the dressings are applied. In these instances the retention bandage must be taken off and replaced. Especially is this true when plaster-of-Paris has been used. If severe pain occurs in a non-infected wound beneath plaster-of-Paris, it should be at once removed. If infection be present at the time of the operation, plaster-of-Paris should not be employed unless ample provision for inspection of the wound be made.

If wounds are packed with gauze, the packing should not be so firmly introduced as to cause pain. A tamponade made for the purpose of arresting hemorrhage should not be rammed in with a director as though the intent were to stop a leak in a steam pipe. It is only necessary to bear in mind that the normal blood pressure needs only to be overcome, and that light pressure with the finger in the abdomen readily controls the flow of blood in the aorta. All that is necessary is to fill the bleeding cavity with gauze to moderate distention. If severe pressure is made, the meshes of the gauze are buried in the tissues, and when the gauze is removed, the coagulum is torn away and fresh bleeding may occur. The gauze takes no part in the repair of divided blood vessels and capillaries. These are obliterated by blood clot and later by scar tissue, and the gauze simply acts as a plug until this has occurred. Packing in wounds should not cause pain.

Still less necessary is it to pack firmly infected wounds. In these cases the intent of the packing is to obliterate blind spaces and cause infective secretions to find their way into the gauze and out of the wound by capillarity. Firm packing prevents the intent mechanically, and the gauze should be so placed in the wound as to permit of ready egress of the offending material.

CHAPTER XIV

FEEDING AFTER OPERATION

Feeding by mouth—Rectal feeding.

The diet after operations varies somewhat with the character of operation the patient has been subjected to. Variations in this regard, arising for this reason, will be taken up under separate heads. There is, however, a general principle involved which should be followed in all cases, the foundation of which is that the digestive functions are either arrested or greatly impaired after operations, the outcome of the narcosis as already rather extensively discussed, and because of shock and the disarrangement of the vital functions to be expected as the result of a severe tax upon them. As stated, no food should be given by mouth while the patient is vomiting, and nothing should be given until nausea has disappeared. The administration of agents to "settle the stomach" should be avoided.

FEEDING BY MOUTH

As soon as nausea has disappeared, kumyss or matzoon may be given in small quantities at a time (half an ounce). The second dose of these agents should not be administered until a reasonable period of time has elapsed to determine whether the stomach will reject it or not. This should be about half an hour. The quantity of the second dose should be about the same as the first, and this may be repeated if no nausea appears in fifteen minutes. At the end of three or four hours additional liquid food may be allowed. It is not sufficient to give general instructions in this regard—the orders should be definitely expressed, and execution insisted upon.

If no untoward conditions arise it may be regarded as safe to give almost any liquid nourishment which the patient desires at the end of twenty-four hours. Broths, beef extracts, and the nostrums on the market exploited as being readily assimilated, organic, nitrogenized constituents of diet, are not objectionable as far as their palatability is concerned. It is to be borne in mind, however, that none of these may properly be regarded as of great nutritive value. Soups and broths consist of a solution of inorganics extracted from meat by various processes, all of which involve the application of heat. Heat, of course, coagulates albumin, and the longer heat is applied the firmer is the coagulum and the less liable are the albuminoids to be found in the extracts. It is no great exaggeration to say that soups, broths, and the various so-called peptones prepared by the manufacturer have the chemical composition of urine.

They do, however, have some virtue as far as the water is concerned, and as they hold certain flavoring substances in solution or in mechanical mixture, they fill a certain place in relieving the monotony of liquid food. Milk and its preparations, *i.e.*, its modifications, should be the sheet anchor in liquid nourishment in postoperative cases, as it is in all conditions calling for the administration of liquid diet. Milk contains all the ingredients necessary to maintain life. It is deficient in iron, but this need not be regarded as an objectionable omission when used over a short period of time.

The modification of milk in order to render it more easily assimilable relates to the fats and the treatment of the casein to prevent its firm coagulation. As the fats are most largely digested in the intestine and require for assimilation considerable effort on the part of the digestive functions, these should be quite removed and so-called skimmed milk given for the first twenty-four hours after an operation. In this way most of the fat is removed, though a little is partaken of. However, this small quantity does not call for great labor on part of the pancreas, bile, and intestinal juices, and need not be regarded as objectionable.

With respect to rendering more readily assimilable the casein, this may be achieved by the addition of lime water or fermentation with lactic acid. Kumyss and matzoon are examples of this process, though the carbonic acid gas developed as the outcome of this treatment may be objectionable in some instances. If this be true, then skimmed milk which has had lime water added may be used for a day or two after the operation, and gradually, as the indications are presented, the quantity of fats may be increased. The principle to be kept in view is to lessen the burden of digestion and yet not withdraw nourishment.

All operative cases have fever from some cause, the most common, of course, being the outcome of exaggerated metabolism in the effort the economy makes in repair. This rise of temperature does not, as a rule, persist after the third or fourth day unless it be the expression of infection. Until, then, the temperature approaches the normal, liquid food only should be allowed, on the grounds stated.

Peculiar methods of treating postoperative cases by starvation and the administration of only water or substances which are soluble in water are to be deprecated. There is no other source of energy, as has been stated before, than the food taken into the body, and while excessive strain upon the organs concerned in preparing nutritive constituents into assimilable substances is to be avoided, the entire withdrawal of the organic nitrogenized constituents and the fats is also unwise. Sugar is certainly soluble in water, yet its conversion into glucose is an exceedingly complicated process and unquestionably entails greater effort in digestion than do the albuminoids, which, as is well known, are digested very largely in the stomach.

If physiology is to be believed, the body will be better able to furnish the constituents necessary to combat the outcome of surgical attack if it be furnished by the ingesta with the material to do it.

If no infection be manifest by the fourth day, it is proper to furnish the patient's digestive organs with the fibrin so necessary to life, and this is best given in the form of lean meats, which at first are given only once daily and later twice daily. Repair of injury will be enhanced by observation of certain well-established physiological laws, one of which is that man is essentially an omnivorous animal, as shown by the anatomy of the digestive tract. Finally, it is well to remember that the dissociation of the various constituents of so-called vegetable diet requires considerable effort on the part of the digestive organs.

Especially is nourishment to be maintained if the operation be undertaken for the relief of an affliction which has already severely taxed the patient's resistance. In this instance it is best to err on the side of excessive nourishment, provided the digestive organs give no evidence of inability to perform their functions. The adjustment of this question will call for the exercise of considerable judgment on the part of the attendant, who is admonished to study carefully the case and be guided by the general rules here laid down. Alcohol, morphin, and the like are, of course, to be avoided. Yet, as stated under the head of preparation of the patient, the time to effect cure with regard to habits of this sort is not either immediately before or after an operation.

Alcohol itself presents a slightly more complex problem. It is, no doubt, fair to say that it should be avoided if feasible, bearing in mind that it has a certain place in the science of medicine aside from the question of the propriety of its use from a social, moral, or economic view. If the patient requires alcohol it should be given under the directorate of the attendant, in response to certain well-known manifestations, and its administration carefully controlled.

To totalize the proposition, give nothing by mouth until nausea ceases, use skimmed milk, kumyss, and matzoon for the first twenty-four hours, and liquid food when there is fever. As soon as the postoperative fever is over give ordinary articles of diet as the digestive organs show evidence of being able to handle them.

RECTAL FEEDING

If vomiting and nausea persist beyond twenty-four hours after the operation, rectal feeding must be resorted to. Life may be maintained for weeks by rectal alimentation. It should not be reserved as a desperate measure in postoperative cases. As stated, if the indications justify it, it should be begun at the end of twenty-four hours. For this purpose, six ounces of milk which has been peptonized by the cold process should be permitted to enter the rectum from a fountain syringe through a small rectal tube, every four to six hours.

The rectum, if necessary, should be cleansed by an enema before the first nutritive enema is given. Each nutritive enema need not be preceded by cleansing of the rectum. The frequent manipulations in this situation cause irritation, and if nutrition need be carried on in this way for more than a day, one cleansing enema in twenty-four hours is sufficient, though in some cases this, as the outcome of natural catharsis, may be unnecessary. A nutritive enema need not be given oftener than every four hours, and one every six hours is preferable. Alcohol or medicinal agents may be incorporated in the enema, bearing in mind, of course, that the dosage required is larger when administered in this way.

An attempt has been made to give in this way a pint or more of nutritive substance at one dose, injecting it high into the sigmoid. This has not been found serviceable, however, the agent being expelled soon after introduction, due to the fact that absorption of nutritive substances from the sigmoid and rectum is slow, and large quantities of these cause irritation. This does not apply to the introduction of saline solutions, no doubt owing to the fact that water readily enters the circulation in this way.

If the necessity for maintaining nourishment for more than two or three days arises, as is at times the case following operations upon the stomach or upper portion of the intestines, feeding by the rectum may be varied from the method mentioned above. Milk proteids are, according to *Lucle, Huber,* and *Ewald,* not readily absorbed unless peptonized, and eggs alone are very slowly absorbed unless twenty grains of sodium chlorid are added to each egg. Raw beef juice is rapidly absorbed, as might be expected, since it contains but little albumin and, indeed, not sufficient in quantity to constitute a helpful nutritive constituent. Peptones are well absorbed.

Glucose is rapidly taken up if it is not in concentrated solution, in which event it is likely to irritate the mucosa of the rectum or colon and be expelled. It should not be used in solution stronger than 15 per cent., nor in larger quantity than 300 c.c. at a single injection, the injections being given six hours apart. Starch even in the raw state is well absorbed, and is not irritating.

Fats are very slowly absorbed, which is, of course, to be expected, as the emulsification of these substances is carried on in this situation by the intestinal secretions, which have, of necessity, undergone considerable change of composition when they reach the large gut, and more especially the rectum. Not more than ten grammes of fat are absorbed in a day, and then only when sodium chlorid has been added to the mixture. The fats of milk are slightly more readily taken up than other kinds. Alcohol, in the form of whisky, wine, or brandy, well diluted, is taken up very readily. Brandy, being a grape-end product, is perhaps more serviceable in this connection than the grain alcohols (whisky).

Adding up the situation, it would seem that the substances mentioned are absorbed with expediency in the following order: alcohol, albuminose or peptones, eggs with salt, beef juice, unboiled starch, diluted solutions of grape sugar. Milk, while not freely taken up in its raw state, when peptonized makes the best vehicle for all nutritive enemata.

Red wine has been advocated by many observers and its value ascribed to its slight astringency, which quality renders it better borne by the rectum. Fresh blood has been advocated by *Ricketts* of Cincinnati, who uses from five to ten ounces of defibrinated blood daily. The blood must be fresh. The extraction of the fibrin means, of course, a chemical change in this fluid, which robs it of some of its nutritive value. However, *Ricketts* reports having kept a patient alive for six weeks by its use, ultimately achieving a favorable result. The administration of enemata for the purpose of feeding the patient should not be confused with those given with the view of obviating shock, which latter have already been discussed (page 264).

Tuttle uses the following formula:

3 eggs.
½ teaspoonful of salt.
6 ounces of peptonized milk.
1 tablespoonful of rye whisky.

The writer substitutes brandy for the whisky for the reason stated above.

Ewald uses:

2 eggs.
1 glass of red wine.
1 cup of 20 per cent. solution of grape sugar.

This enema may be used when the peptonized milk is not satisfactorily retained.

Boas finds the following mixture suitable in most cases, especially as a routine enema following operations attended with prolonged vomiting:

Milk	250 c.c.
Yolk of egg	2
Salt	1 pinch
Red wine	15 c.c.

As to how long rectal alimentation may be continued is not definitely settled. *Hutchinson* states that it is impossible to develop more than 500 calories of energy daily by this means, whereas at least 1,500 are required by patients to maintain the equilibrium of health. The experiments of *Tournier, Gross, Ewald,* and others do not bear him out in this claim. A patient has been kept alive by this method for twenty-six days, so that an extensive gastric ulcer has been cured because of the functional rest to the stomach; she lost flesh, but was no more emaciated than one often finds after attacks of typhoid fever or other exhausting acute infectious disease (*Tuttle*). It is to be remembered, however, that *Hutchinson* speaks of "maintaining a balance of health," which is an entirely different proposition from keeping a patient alive

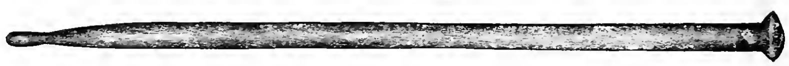


Fig. 215.—*Wales'* Soft-rubber Rectal Bougie. (*Tuttle.*)

who is living also on the adipose tissue and to some extent upon the organic nitrogenized constituents of the body. These are not so readily exhausted when supplemented by a certain nutritive constituent introduced into the rectum and taken up by the circulating fluid. As a rule, it may be said that patients who possess ordinary resistance, and whose calories have not already been inordinately taxed or exhausted by prolonged illness previous to the operation, may be maintained alive and with no alarming reduction of weight for twenty days as the result of judicious rectal feeding. This assumption is quite borne out by clinical experience.

The method of administering these enemata is as follows: The patient is placed in the *Sims's* position with the hips elevated. A No. 5 *Wales* soft bougie (Fig. 215), well lubricated, is gently introduced through the anus and into the rectum, and whatever gas may be present is allowed to escape. The bougie is introduced a distance of $3\frac{1}{2}$ inches. As already stated, the sigmoid rebels more actively against the introduction of substances of this sort than does the rectum, and for the purpose of nourishment. enemas should not be allowed to enter the sigmoid directly. A certain amount of the fluid trickles slowly into the sigmoid in this way and is not expelled.

The fluid should be injected very slowly, using a fountain syringe for the purpose rather than the ordinary rectal syringe. The fountain syringe should not be raised more than two feet above the anal level. The small, soft rubber *Wales* tube is used in order to avoid injury to the anal mucosa when introduced, thus avoiding irritation in this location, which interferes with subsequent manipulations. The fluid should be heated to 100° F. Cold or hot solutions are not well borne by the rectal mucosa, and the enema is likely to be immediately expelled if its temperature is not watched.

The formulæ mentioned above will meet the indications in almost any case. The conception held by the writer with respect to the food value of certain so-called beef extracts is not shared by all observers. For this reason, a number of formulæ are added with the view of meeting the inclination of readers who take an opposite view. The formulæ are taken verbatim from *Tuttle's* work on the "Rectum and Pelvic Colon."

Riegl's formula:

Milk	250 c.c.;
Eggs	2 to 3;
Salt	2 to 3 pinches;
Red wine	30 grammes.

Catillon's formula:

Beef peptone (saturated solution).	50 grammes;
Water	125 grammes;
Bicarbonate of soda	30 centigr.;
Laudanum	4 drops.

Tournier:

Salted bouillon	140 to 150 grammes;
Yolk of egg	2;
Wine	20 to 40 grammes;
Sydenham's laudanum	4 to 8 drops.

Tournier:

Milk	140 grammes;
Yolk of egg	2;
Sugar	10 grammes;
Laudanum	4 to 8 drops.

Tournier:

Bouillon	140 grammes;
Yolk of egg	6;
Wine	20 grammes;
Salt	2 teaspoonfuls.

Tournier:

Water	150 grammes;
Dry peptone	10 grammes;
Yolk of egg	1;
Glucose	20 grammes;
Sydenham's laudanum	4 drops.

Professor *Jaccoud's* formula:

Bouillon	250 grammes;
Wine	150 grammes;
Yolk of egg	2;
Dry peptone	4 to 20 grammes.

Lathier employs:

Dry peptone	3 teaspoonfuls;
Yolk of egg	1;
Milk	125 grammes;
Tincture of opium	5 drops;
Starch-powder	5 grammes.

Adamkiewicz recommends:

Dry peptone	100 grammes,
Flour	300 grammes;
Oil	90 grammes;
Salt	30 grammes;
Bouillon	1,000 grammes.

In several injections.

Fleiner:

Bouillon	200 grammes;
White wine	50 grammes.

Singer uses:

Milk	125 grammes;
Wine	125 grammes;
Yolk of egg	1;
Salt	2 grammes;
Witt's dry peptone	1 teaspoonful;
Glucose	2 grammes.

Schlesinger employs:

Milk	200 grammes;
Eggs	2;
Wine	15 grammes;
Rice flour	6 grammes;
Salt	2 pinches.

Ratjen uses:

Milk	250 grammes;
Yolk of egg	2;
Salt	1 pinch;
Red wine	15 grammes;
Starch	15 grammes.

It will be noticed that some writers add a small amount of opium to the mixture. This has some advantages in cases when prolonged rectal feeding is necessary. The small amount of opium contained in each enema does not have a noticeable constitutional effect upon the patient, being intended only to soothe the irritated mucosa. On the other hand, the presence in the fluid of an opiate lessens the rapidity with which the nutritive constituents are absorbed. The mucosa does not functionate as well when the opium is used as it does without it. A certain amount of discretion will have to be exercised in this connection. At times copious lavage of the lower gut through a *Kemp* return tube will cleanse very thoroughly the mucosa, which, when rested for six hours, will again take up its function and permit of the resumption of this avenue of nutrition.

CHAPTER XV

CARE OF WOUNDS AFTER OPERATIONS

Time of changing dressings—Preparation for change of dressings—Exposing the wound—Removal of stitches—Cleansing and drainage of infected wounds.

The primary dressing of operative wounds has already been described and its rationale discussed. With the application of the retention bandage, the office of the surgeon ceases in a large number of instances, and the subsequent care of the wound evolves upon the practitioner. This has led to more annoying complications as regards the relationship the practitioner bears to the patient than, perhaps, any other phase of the treatment of operative cases. For instance, the occurrence of stitch abscess ten or twelve days after the operation is frequently regarded as the outcome of a factor for which the practitioner is held responsible. That this is a faulty conclusion has already been shown. However, it is probable that infection of the wound may take place subsequent to the operation, as the result of faulty technic.

It is also true that at the end of several days after the operation the process of repair has advanced sufficiently far to make infection exceedingly unlikely, and that ordinary precautions will avoid this contingency. The more remote the first disturbance of the surroundings of the wound is from the time of operation the less liable is infection to occur, and this argues for the avoidance of early interference with wounds as long as there is no direct indication to the contrary. This assumption is borne out by experience, and if the general trend be that of conservatism and patience rather than meddlesome enthusiasm, the interests of all are best conserved.

The surgeon is warned that a heated denunciation of the practitioner's lack of skill in the after-care of the wound is objectionable, and more so as the infection may easily have been the result of some occurrence at the time of the operation, and the practitioner be in no wise responsible for it. Frequently, the result of unavoidable infection of the wound is that the practitioner and the surgeon devote considerable time and effort in useless attempts to fix the responsibility of a late skin infection upon each other, when, as a matter of fact, neither may be responsible. Certain it is that this possibility should cause both to avoid display of annoyance for the benefit of the family and friends.

The after-care of operative wounds varies with whether drainage has been employed. Clean wounds in which no drainage has been used will heal without change of dressing, and the latter need not be removed until the tenth day in order to remove the sutures. If the suture material used in the skin is catgut, the dressing need not be removed for this purpose, but should be changed in order to permit of cleansing of the parts contiguous to the wound which have been covered by the protective dressing and where secretions have accumulated. Indeed, in cases where an elaborate protective dressing has been applied, the outer dressings may be changed on the fourth or fifth day, but the portion of dressing immediately contiguous to the wound need not be and, indeed, is best not disturbed at this time.

Frequently the patient will complain of itching and irritation in the skin beneath the dressings, and if the bandage or binder be released, the skin sponged with alcohol and warm water, and a clean outer dressing applied, the comfort given the patient will be found exceedingly desirable. As has already been stated, non-absorable suture material is less likely to be complicated with stitch abscesses than the absorbable variety, and requires removal at the end of ten days. It is to be remembered that the removal of stitches disturbs the repair process which has taken place in the line of the buried portion of the suture, and this trauma, slight as it is, makes again a field which is susceptible of infection, though, of course, this is not as likely to occur as obtains during the operation itself.

TIME OF CHANGE OF DRESSINGS

The indications for removal of the dressings in wounds which have not been drained are expressed in the temperature and pulse rate. Indeed, in the usual symptoms of inflammation. This does not mean that rise of temperature or increase of pulse rate at the end of forty-eight hours after an operation calls for change of dressings. Indeed, this may be due to a number of causes, but if the temperature and increased pulse rate persist into the third or the fourth day, and are not accounted for by other causes, the dressings should be removed and search made with the view of disclosing local conditions which account for the disturbed metabolism.

In these instances infection of the wound will, no doubt, be manifest, and the release of one or more of the sutures will give opportunity for the discharge of the inflammatory exudate, and in the vast majority of instances this measure will afford relief of the symptoms, and the only setback to meet will be the fact that healing by granulation will take place instead of primary union.

When the wound is dressed for the purpose of removing stitches which are no longer of service, or with the view of discovering and treating infection, the technic of the procedure is the same. All the material which comes in contact with the wound and its immediate surroundings should be sterile. This is, of course, more imperative when the protective dressing is disturbed soon after the operation than if the ten days spoken of above have been allowed to elapse. However, the precautions should be just as rigidly enforced in the latter instance.

As the change of dressing usually takes place when the patient is in bed, either in the hospital ward or room, provision should be made for transportation of sterile material. In hospital practice this is quite a matter of routine and, indeed, in private practice the preparation of dressings, as already described, renders the problem quite simple. Whatever the selection of the surgeon may be as to asepsis or antisepsis with regard to operating-room technic, there can be no doubt that the latter is the more advisable when the dressing is changed.

PREPARATION FOR CHANGE OF DRESSING

The prolonged preparation of the hands necessary to cleanse the skin would entail considerable hardship upon the attendant.

Indeed, if it were necessary to go through the same elaborate mechanical and chemical cleansing of the hands necessary to achieve the purpose each time a case were dressed, the attendant would not have much skin left. When dressing cases, the rubber gloves fill an exceedingly useful purpose, and a pair of sterile gloves should be prepared for the attendant for each case. As there is no violent manipulation attendant upon changing the dressing, gloves are not frequently perforated during the dressing, and the question of economy is not so important a factor. A convenient method of handling gloves is to have each pair wrapped in a towel together with a small quantity of talcum powder in a small envelope, which are readily sterilized in the steam sterilizer. The gloves can be readily transported in this way, and when about to be used, the nurse opens the package and the attendant dusts his hands with the powder and slips into the left glove, being careful not to touch any portion of the glove except the gauntlet, which is, of course, not allowed to come in contact with the wound or its surroundings. The right glove may now be lifted with the fingers of the left gloved hand, and as these are sterile, the manipulation need not be limited to the gauntlet. If the glove on the left hand is not properly adjusted by the first act, it may be manipulated into place by the right, as now only sterile surfaces come in contact with each other.

The attendant does not remove the outer dressings, but has the nurse cut the bandages or loosen the binder, as the case may be, and remove the combination dressing.

For purposes of illustration, a description of the technic of dressing a wound is given in connection with a wound of the thigh, but is to be regarded as applicable to all portions of the body.

For the purpose the nurse should prepare:

Six sterile towels.
Basin with wipes in carbolic acid 1 in 100.
Pus basin.
Kelly pad.
Bandage scissors.
Tray with sterile scissors for cutting dressings.

Thumb forceps, plain.
Scissors for cutting stitches.
Dressing forceps.
Director.
Glass nozzle for irrigator tube.
Package of four-by-four sponges.
Package of two-by-two sponges.
Irrigator containing solution of bichlorid 1 in 1,000.
Hydrogen peroxid.
Same dressings as used at operation.

EXPOSING THE WOUND

The thigh is exposed together with its encasing dressing, and the outer bandage and the dressings down to the last piece of gauze, which is usually found adherent to the wound, are removed. The parts immediately contiguous to the wound are protected with sterile towels (Fig. 216), in order to obviate contamination of any of the instruments, sponges, etc., which may come in contact with these parts. It is wise to slip a *Kelly* pad under the dependent portion of the part in order to catch fluids which are used in the dressing. However, unless irrigation or copious lavage is necessary, a simple pad of absorbent cotton or a few towels folded upon themselves and placed at the dependant part will suffice for the purpose.

A gauze or cotton "tupfer" is now removed from the basin containing the carbolic solution (1 in 100), and the fluid allowed to drip over the portion of gauze corresponding to the area of the wound. The latter is usually clearly indicated by the stain from the secretions of the wound (Fig. 216). This moistens the gauze and permits of its more easy removal. However, in some instances the dry crust consisting of blood and antiseptic powder is rather tenacious, and the measure indicated is not effective. In these instances force should not be used, but a glass syringe is filled with hydrogen peroxid and the latter injected under the edge of the adherent gauze. The effervescence which occurs as the outcome of the contact of the secretions and the peroxid of hydrogen will usually gently lift the gauze from the wound without giving any pain to the patient. If necessary the injection may be several times repeated if the first application does not suffice.

The habit of forcibly tearing the dressings from wounds is to be deprecated, not alone on the ground that unnecessary pain is inflicted, but because the trauma, slight as it is, to the edges of the wound favors late infection and delay in repair.

After the last piece of gauze has been removed the wound

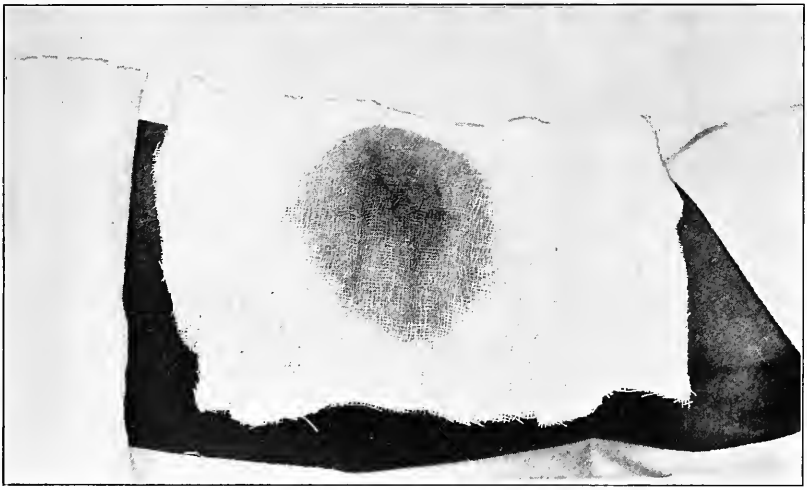


Fig. 216.—Gauze in Contact with Wound.

and surrounding skin is cleansed with the carbolic acid or corrosive sublimate solution, using for the purpose the gauze wipes or tabs of cotton. Care should be exercised in this connection not to wipe the wound with a sponge which has been used for cleansing of the surrounding skin or vice versa, *i.e.*, after the wound has been wiped the sponge is thrown aside and a fresh one used. This also applies to sponges used on the neighboring skin. The rationale of this precaution is obvious. Too frequently will the interne or nurse swab the skin and then apply the soiled sponge to the wound. This is a fair way to introduce infection into the wound.

If the quantity of secretion be large, the cleansing of the parts may be supplemented by irrigation with corrosive sublimate solution. However, it is best not to employ this measure relying more upon the former method.

REMOVAL OF THE STITCHES

This simple measure may be performed in a manner which will stand in a causative relationship to late superficial infection. If the wound be clean, the next step is to remove the stitches with the minimum of annoyance to the patient, and with the view of preventing infection. Commonly the stitch is lifted by the end of the suture near the knot, scissors are slipped under the stitch, and after its division the thumb forceps are used to remove the stitch. This method of procedure is painful and somewhat awe-inspiring to the patient, despite the frequent admonitions of bystanders "not to look." The writer employs for the purpose a probe-pointed scissors (Fig. 217), the lower blade of which is slipped under the portion of the suture distal from the knot (Fig. 218). This makes but little tension on the suture, especially if the lower blade of the scissors is slightly depressed into the skin, as shown in Fig. 218. The little manipulation is accomplished with one

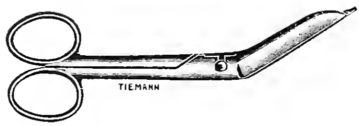


Fig. 217.—Angular Probe-pointed Scissors for Ready Removal of Stitches from Wounds.

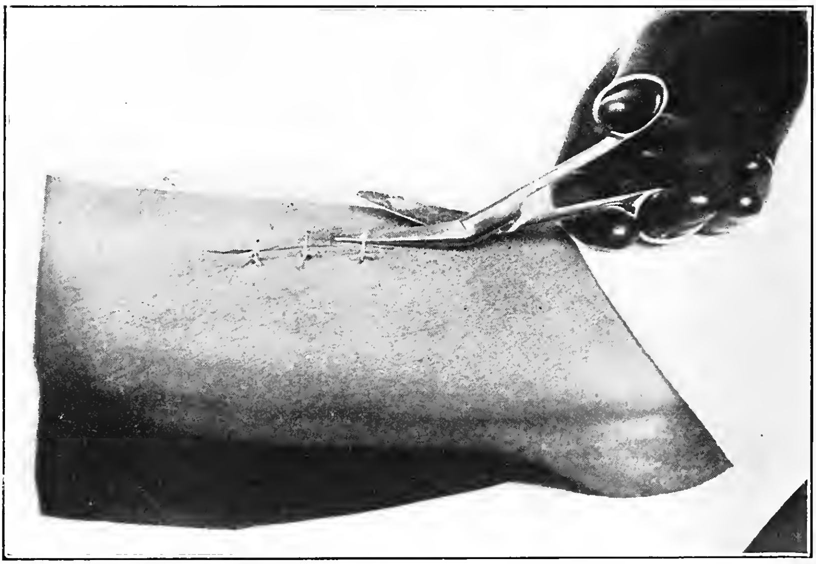


Fig. 218.—Removing Suture from Wound with Probe-pointed Angular Scissors.

hand and the suture is cut. The knot is now seized with the thumb forceps and the suture is withdrawn. It must be borne in mind that the portion of the suture lying on the skin is likely to be the habitat of bacteria, and this should not be dragged through the suture bed, but the division of the suture should take place near its point of egress, as shown in the illustration. The measure is, of course, repeated for each stitch. If a continuous suture is employed, each crossing of the suture material is separately divided, taking the same precaution to avoid dragging of the superimposed part of the suture through the suture holes.

CLEANSING AND DRAINAGE OF INFECTED WOUNDS

If the wound be infected, it will show itself in redness and puffiness, most marked at the site of the sutures.

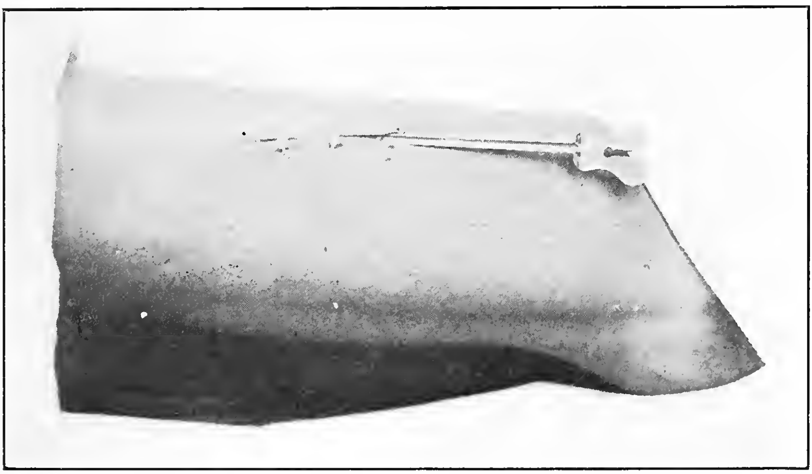


Fig. 219.—Director Introduced into Wound in Search of Infective Secretions.

In these instances it is wise to leave *in situ* as many sutures as is feasible, to obviate wide separation of the lips of the wound, especially as infection usually manifests itself upon the fourth or fifth day after the operation, and repair at this time is not sufficiently advanced to permit of their removal. A single suture is now released in the manner described, and a director introduced into the wound (Fig. 219) with the view of disclosing the site of suppuration in order that only such sutures be removed to liberate infective material and yet maintain apposition of the divided structures. Usually the most dependent suture is removed at first to facilitate subsequent drainage. This argues for the employment of interrupted sutures in the skin, and that they should be of material which will withstand rapid absorption and manipulation. If the infection be located in this way, the upper suture may now be removed and the wound irrigated with a solution of corrosive sublimate 1 in 1,000, using a conical

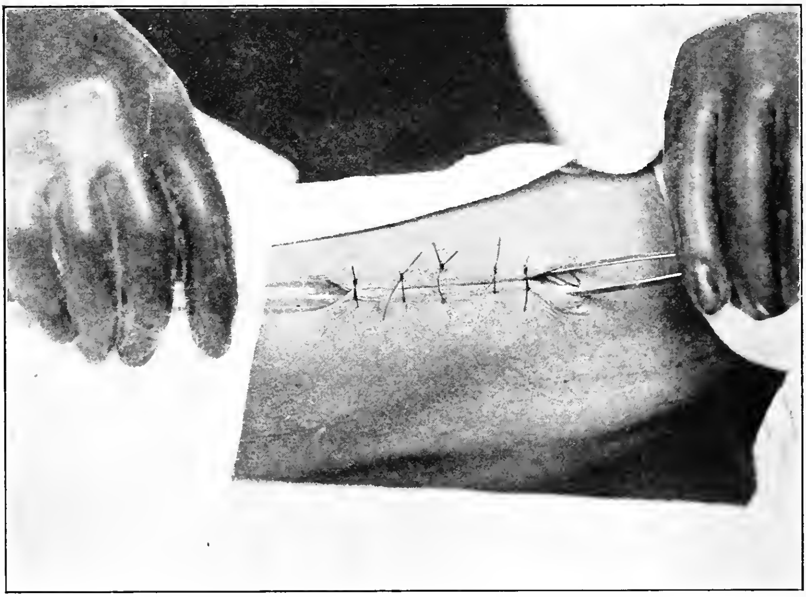


FIG. 220.—METHOD OF CLEANSING AN INFECTED WOUND.

pointed glass nozzle connected with an irrigator. The glass nozzle is introduced into the upper end of the wound, and the lower end is gently held apart with slender forceps to facilitate discharge of the fluid and to prevent undue distention pressure upon the wound, which might separate it unnecessarily (Fig. 220). The injection of peroxid of hydrogen into the wound is objectionable at this time for the same reason. It may, however, be effectually employed when repair in the portion of the wound between the two exit holes has advanced farther. After the infective secretions have been entirely removed and the solution appears clear at the dependant side, the irrigation is discontinued and the residual solution gently expressed. A probe armed with a small layer of cotton soaked with iodin may now be introduced the entire length of the wound with the view of destroying bacteria. This measure has been found exceedingly effectual at the hands of the writer. The smarting sensation experienced by the patient is a minor consideration and disappears in a few moments. The attendant is warned that the iodin will, when coming in contact with gauze, convert the

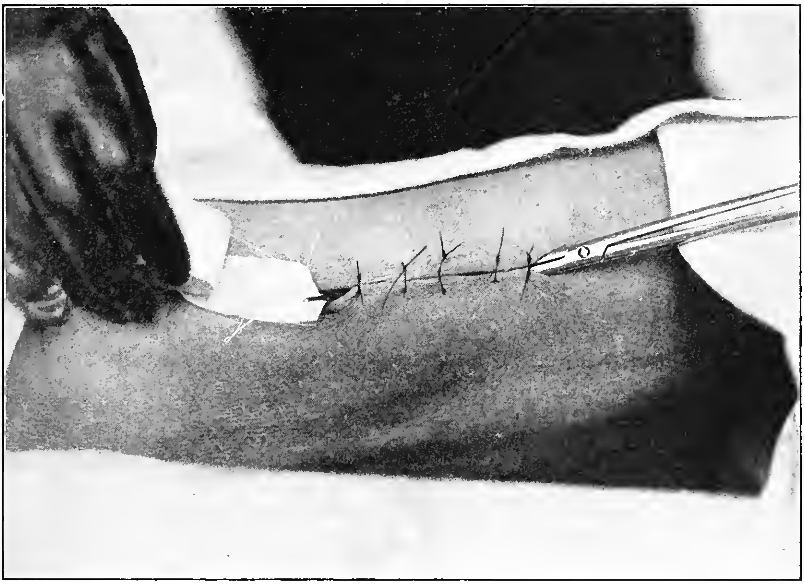


Fig. 221.—Dressing Forceps Introduced Through Wound. Gauze seized preparatory to introduction.

starch in the gauze into the blue iōdid of starch and may lead to the faulty notion that the wound is infected with the pyocyaneus bacillus. Drainage is now established. This may be accomplished in the manner already described under the head of drainage or, as is better, a dressing forceps is passed from end to end (Fig. 221) through the wound and a piece of gauze pulled through (Fig. 222). The diameter of the gauze depends, of course, upon the size of the wound. It should not be sufficiently bulky to cause pressure which would interfere with capillarity. If the gauze be moistened before introduction with carbolic acid solution its introduction will be facilitated and final capillarity enhanced.

Infected wounds should be dressed every twenty-four hours, irrespective of systematic indications. As strongly as non-interference is advocated for non-infected wounds the proper cleansing of infected wounds is equally strongly insisted upon. The drain should, at the second dressing, be shortened. This is accomplished by cutting off the portion protruding from the upper end of the wound and withdrawing the gauze through the lower

Fig. 222.—Gauze Drainage *in situ.*

opening. The object of cutting off the protruding upper end is to prevent the portion of the drain which has been in contact with the skin from being dragged through the wound.

The wound is now cleansed, as stated above, and if the quantity of infective secretion be small, a shorter drain is introduced into the lower opening, which latter is replaced by a shorter piece of drain at each dressing until the discharge ceases. This rarely requires more than ten days. The upper opening may, if there be undue gaping be held in apposition with sterile adhesive plaster. The lower opening is treated in the same way after the drain has been permanently removed.

These measures are applicable in cases of moderate infection of the superficial wound. In instances where infection of the deeper tissues occurs with cellulitis, the measures need be somewhat more radical. In these cases all the superficial sutures should be removed and the site of infection directly attacked.

The patient will probably require narcosis, though in some cases the instillation of a one per cent. cocain solution will control the pain sufficiently to permit of the necessary manipulations. After the wound and surrounding parts have been cleansed in the manner just stated, the superficial sutures are removed and the deeper layer searched in the same manner, with the director, as described above. Here, again, it may not be necessary to remove all the sutures, and if some may be left *in situ,* repair will be conserved. The upper and lower stitches may be removed and

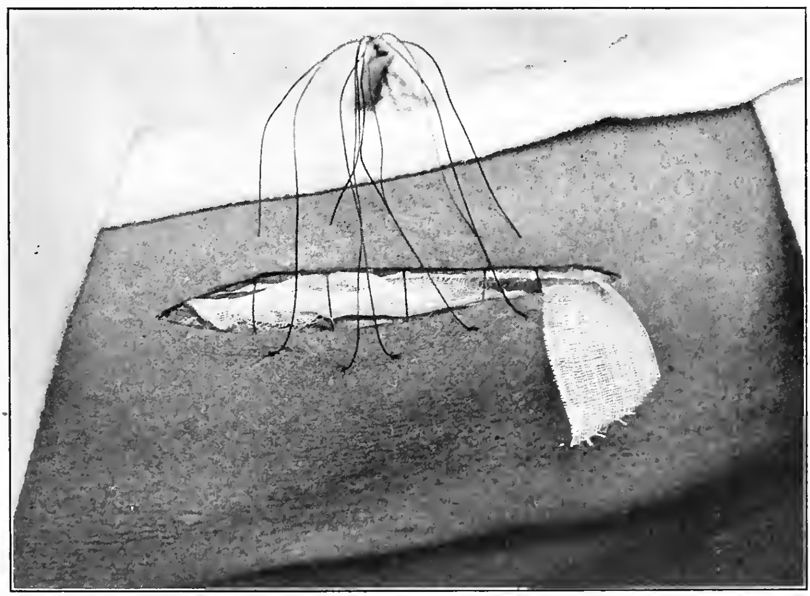


FIG. 223.—INFECTED WOUND PACKED WITH GAUZE AND SUTURES PLACED.

the deep wound cleansed with the antiseptic fluid. A drain is passed beneath the suture line, as described above, the ends of which are permitted to protrude well beyond the limits of the wound.

The superficial wound is now loosely packed with iodoform gauze. The packing should not make pressure, but should be allowed to comfortably fill the wound cavity. As infection may be controlled by these measures, provision should at this time be made for coaptation of the edges of the wound when infection has been arrested. For the purpose, interrupted silk-worm gut sutures are introduced and left loose, being held at their distal ends with a serre-fine. Fig. 223 shows a wound packed and the sutures held by a forceps.

The protruding portion of gauze is intended to facilitate removal of the packing. At the next dressing this is seized with dressing forceps, and after the gauze packing has been thoroughly saturated with the cleansing solution, it is gently removed by twisting it upon itself. Hydrogen peroxid may be used for the purpose as the avenue of egress for the bubbling mixture of blood, and the peroxid is ample under these conditons.

When the infection is controlled, the edges of the wound are held in apposition by tying the sutures in the usual manner, leaving, however, the upper and lower corners of the wound slightly open, with the view of making any necessary cleansing more readily accomplished. This measure saves much time in ultimate repair and prevents an unnecessary degree of scarring. Indeed, it not infrequently happens that the infection subsides at the end of three or four days as the outcome of the drainage and light packing, and the early approximation of the edges of the wound makes possible an ultimate result not greatly at variance with that obtained with primary union.

CHAPTER XVI

OPERATIONS ON THE SCALP, SKULL AND BRAIN

Operations on the scalp: Preparation of the narcotist—Preparation of the scalp—Care of wounds.

Operations on the cranium: Kroenlein construction—Care of wounds of cranial bones.

Operations involving cranial contents: Bone necrosis—Secondary hemorrhage—Retention of cerebrospinal fluid—Edema and softening of the brain substance—Discharge of cerebrospinal fluid—Brain prolapse—The retaining bandage—Mastoid operations—Intracranial neurectomy.

OPERATIONS ON THE SCALP

PREPARATION OF NARCOTIST

Asepsis during operations on the head is not readily obtained and calls for especial precautions. The presence of the narcotist immediately contiguous to the operative field, the secretions from mouth and nose, the occasional discharge of vomitus, all contribute to the factors which enhance the difficulties in this connection.

It is a good rule to have narcosis produced by one assistant, while a second prepares for the narcosis during the operation. The patient is narcotized in the ante-room by the first assistant after the usual preliminary preparation of the operative field has been made and is then transported to the operating room and placed on the table.

The non-sterile attendant carefully removes the superficial retaining bandage holding the protective dressing in place without coming in contact with the subjacent gauze and the narcotizer, who has prepared himself in the usual manner (Fig. 85) and who wears a sterile gown, cap, mask and gloves, takes charge of the narcosis, using a sterile cone or mask for the purpose.

The operation may then proceed with the element of infection, as far as the narcotist is concerned, eliminated. The care of the nose and mouth in operations in their field is taken up under a separate head.

Vomiting during the operation may be controlled by judicious administration of the narcotic. This suggests that novices should obtain their education in this connection on cases other than those involving operations on the head.

PREPARATION OF SCALP

The preparation for operations on the scalp cranium, and contents of the cranium, does not differ as regards local steps. As a rule, the entire scalp should be shaved. In cases requiring surgical interference of magnitude this is a minor consideration. However, in cases which involve only the removal of benign growths, such as a sebaceous cyst, removal of the entire hair is perhaps unwarranted. Especially is this true if the patient be a woman.

In these instances the following technic will be found serviceable and, no doubt, justifiable. The portion of scalp to be attacked, together with a space surrounding it an inch in breadth, is shaved and the entire scalp thoroughly anointed with olive oil or white vaseline. This is done the evening before the operation, the object being softening of the dried sebaceous secretion with which the scalp is always more or less covered. An hour before the operation the scalp is thoroughly shampooed with an alkaline green soap, the alkali being intended to saponify the greasy mixture of the application and the softened sebum.

The resultant lather is freely lavaged with sterile water. Corrosive sublimate solution should not be employed for this purpose, as the alkali in the soap may precipitate the mercury, which, though not particularly objectionable, had best be avoided. The corrosive sublimate solution may be used for its cleansing effect after the soap has been removed by lavage with sterile water.

The hair should now be dried with a sterile towel and braided (in women) in such a way as to direct it away from the field of operation. A dressing of fluffed sterile gauze may now be applied to the head. Immediately before proceeding with the operation the dressing is removed and the denuded area painted with tincture of iodin. This latter step takes place after narcosis is established, or in the event of local anesthesia, after the patient has been conveniently postured and before application of the local anesthetic is made.

In order to isolate with certainty the operative field, a goodly sized square of gauze composed of several layers of this material is prepared. About six layers of gauze are used, between the center layers of which a sheet of elastic rubber is placed. An opening a little larger than the dimensions of the operative field, but not quite as large as the denuded area, is cut into the gauze protector, and this is fastened near the margins of the hair by means of sutures of very fine silk introduced with a slender needle (Fig. 224).

Fig. 224.—Method of Isolating Portion of Scalp by Sterile Gauze Protector.

It is quite impossible to place sterile towels in contact with the hair, and prevent their dislodgment during the surgical manipulation, and the gauze fastened in the manner stated effectually isolates the field, rendering the introduction of infectious material from the contiguous surfaces quite unlikely. The elastic rubber sheeting prevents soiling of the hair with blood, secretions, and cleansing fluids used during the operation.

The object may be attained by fastening small towels around the operation field in the form of a hollow square, the crossings of which are held fast to the scalp by means of small clamps specially constructed with sharp biting ends. This, while quite useful, is not as effective a measure as the one stated above. The sutures holding the protector are not removed until the operative wound is protected by the first layers of the dressing.

The points of contact of the edge of the opening in the protector may be sealed with collodion to obviate trickling of the cleansing solutions, etc., beneath the protector.

Wounds of the scalp heal very readily and do not become infected with frequency. Both these characteristics are explained on the ground that the scalp is very vascular and that the presence of glandular elements in large number conserves the process of repair. Fine silk-worm gut or horsehair are the suture materials of choice in this class of cases.

CARE OF WOUNDS

Drainage of wounds of the scalp is not usually necessary. If, however, the subaponeurotic space has been invaded and the surgeon be not reasonably certain of the asepsis during the operation, a small drain consisting of horsehair or silk-worm gut (page 193, Fig. 147) may be introduced and left *in situ* for several days. If infection occurs and the purulent material gains access to the subaponeurotic space, drainage of the wound itself will not suffice in all instances. The infection is exceedingly likely to invade the loose connective tissue beneath the galea and cause an edematous infiltration of the entire scalp.

The edematous infiltrate puffs up the entire surface of the cranium and, indeed, invades the upper eyelids. Patients afflicted in this way suffer considerable pain, and, indeed, if the periosteum be infected, present the picture of an alarming condition. The severe pain is due to pressure upon the periosteum, which is exceedingly sensitive. The constitutional symptoms are quite suggestive of a deep erysipelas.

When this occurs the wound should be opened at once, carefully and thoroughly cleansed with a solution of corrosive sublimate 1 in 2,000, and lightly packed with iodoform gauze. If the subaponeurotic cellulitis go on to suppuration, drainage openings must be made over either one or both eyebrows, as is indicated by the magnitude of the infection, and the infected space washed through from the wound (Fig. 225). If the infection does not then subside and the "bogginess" extends backward, an additional drainage opening should be made over the external occipital protuberance. For the purpose tube drainage (page 189, Fig. 143) is the most serviceable, as frequent through-and-through lavage may be necessary to obtain thorough cleansing of the infected area. The surgeon is admonished not to err on the side of timidity in these cases, for the reason that, should a suppurative periostitis occur, it is not a long step to invasion of the emissaries of *Santorini*, sinus phlebitis, and possibly abscess of the brain.

Fig. 225. — Rubber Tube Drainage of Subaponeurotic Space of Scalp.

The rubber drainage tube should be of rather firm rubber, to avoid its collapse from pressure of the tense aponeurosis. The rubber tube drainage found in the market is too light for the purpose, and it will be found expedient to use an appropriately sized soft rubber catheter for the purpose.

An infection of the skin alone does not call for these severe measures, as the skin is quite firmly attached to the tissues, and the simple packing of the wound will suffice the indications.

The tubes should not be permitted to remain in the anterior portion of the scalp any longer than necessary. If the drainage openings are maintained for a long time, objectionable scarring occurs. However, the possibility of an unfavorable cosmetic outcome must not act as a deterent with respect to radicalism in this connection, for the reasons stated.

In clean cases the sutures may be left *in situ* for five days, when they should be removed.

OPERATIONS ON THE CRANIUM

Operations on the cranium beyond those undertaken for the repair of trauma comprise resection of diseased areas and invasion of the bone to provide an avenue of approach to the cranial contents. The technic of the two classes of cases differs in the essential respect, that in the cases where the bone is sectioned for relief of disease in this situation the bone is removed, while in the last-mentioned class of cases the bone is saved and replaced after the operation is completed. Consideration of the treatment of fracture of the skull does not belong here, though the after-treatment of wounds in this connection is essentially similar to that of bone trauma for the relief of disease.

When the cranial bones or the contents of the cranium are to be subjected to operative attack, the preparation of the scalp is, in a general way, similar to that described under the head of minor operations in this situation. The entire scalp is shaved, however, and the cleansing is performed as stated. In those cases in which the brain is to be made the object of manipulations, the landmarks are designated upon the shaven scalp (Fig. 226) with the nitrate of silver stick. The scalp may be cleansed again just before proceeding with the operation without eradication of the guides.

KROENLEIN CONSTRUCTION

The illustration shows the situation of the fissure of *Rolando* and that of *Sylvius* according to the *Kroenlein* construction. In instances in which the surgeon operates without previously seeing the case, the physician in charge is expected to locate these two fissures in the manner stated before narcosis is induced. As a matter of fact, this should be done in all instances, and the patient thus escapes unnecessary prolongation of the narcosis. The physician in charge should acquaint himself with the method of arriving at these locations and proceed patiently twenty-four hours before the operation to mark out the necessary guides.

The following description is quoted from *Krause*, "Surgery of the Brain":

Localization is most readily accomplished when the situations of the fissures of *Rolando* and *Sylvius* are determined. The simplest

FIG. 226.—FISSURE OF *Sylvius* AND *Rolando* OUTLINED WITH NITRATE OF SILVER. (*Krause.*)

method of arriving at a conclusion in this regard is the *Kroenlein* construction, which is taken from his own illustration and shown in Fig. 227.

In order to rapidly locate these two lines *Kroenlein* employs a craniometer made for himself by the instrument makers, *Hanhart & Ziegler*, of Zurich. It is my practice to delineate these lines on the shaved scalp twenty-four hours before the operation with the nitrate of silver stick (Fig. 226).

The following additional lines are outlined on the scalp:

1. The base line (the German horizontal line) is in accord with the Frankfurt agreement, drawn from the lower rim of the orbital cavity, backward through the highest point of the external auditory meatus.

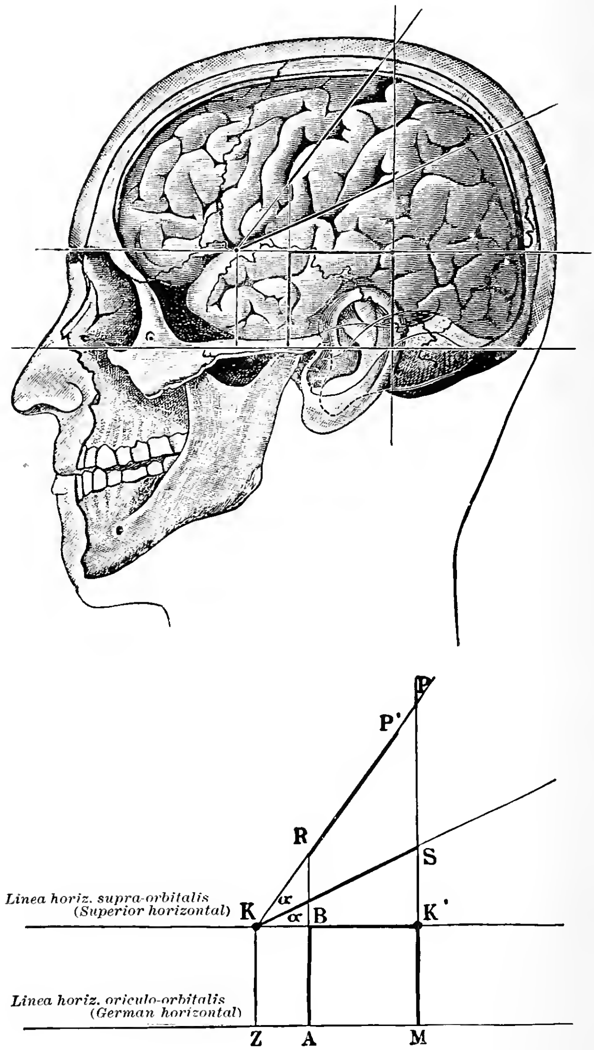


Fig. 227.—*Kroenlein* Construction for Locating the Central Sulcus, and the Fissure of *Sylvius* on the Surface. *K*, Division of fissure of *Sylvius;* *S*, Posterior end of fissure of *Sylvius;* *R*, Lower end of central culcus; *P*, Upper end of central sulcus.

2. The upper horizontal line parallels the first on a line with the upper edge of the orbital cavity.

3. The front vertical (Z) line runs vertically between the first and second through the center of the zygomatic arch.

4. The middle vertical line (A) crosses the center of the articular knob of the inferior maxilla.

5. The posterior-vertical line (M) crosses the posterior edge of the mastoid processes.

The linea *Rolandi* (RP) connects the intersection of the front vertical and the upper horizontal (K) lines at a point where the posterior vertical meets the median line (P).

The linea *Sylvii* (KS) halves the angle (Pkk); this is prolonged backward to the posterior vertical line. Further elucidation may be obtained from Fig. 227.

Kroenlein bases his work on the observations of *A. Froriep*, whose construction in general is figured with respect to various forms of skulls, taking into account short, high or long low forms of heads. In the first class of cases *Froriep* thinks the brain is crowded toward the forehead and would indicate that the fissure of *Rolando* lies farther forward. (Frontipetal type.) In the latter class the brain appears to make a turn upon its horizontal axis and its posterior is crowded backward, constituting a displacement backward of the entire brain, thus causing the central sulcus to lie more obliquely backward. (Occipitopetal type.) The same respective displacements of all convolution and fissures occur in the same proportion. "The more marked," says *Froriep*, "the length of the posterior segment of the skull is and the more the external occipital protuberance lies toward the horizontal or beneath it, the more certain may the occipitopetal type with a corresponding position of the brain be taken into account. *Per contra* the frontipetal type is to be expected when the audito-occipital distance is short and the posterior segment of the skull is high."

Figures 228 and 229 represent the two types as described by *Froriep*, though the differences are quite strongly drawn. The squares surrounding the sketch correspond to the long diameter and the height at the ear line of the skull. The inferior edge of the orbital cavity is indicated on the audito-orbital line, as is also the location of the auditory meatus. The dotted line running upward at the latter situation makes quite apparent the differences in frontipetal or occipitopetal types of brains. The averaging of a number of measurements would indicate that the most frequent variation in position of the brain is that of rotation on its transverse axis combined with displacement downward and backward.

For these types *Froriep* emphasizes that "the total length of the skull, rather than the longitudino-transverse index, indicates the conditions. If the total length is beyond a certain dimension the occipitopetal type presents and *per contra*, if this be below a certain measurement, the frontipetal type obtains. Although the importance of increased vertical diameter is not to be disregarded, neither the brachy-

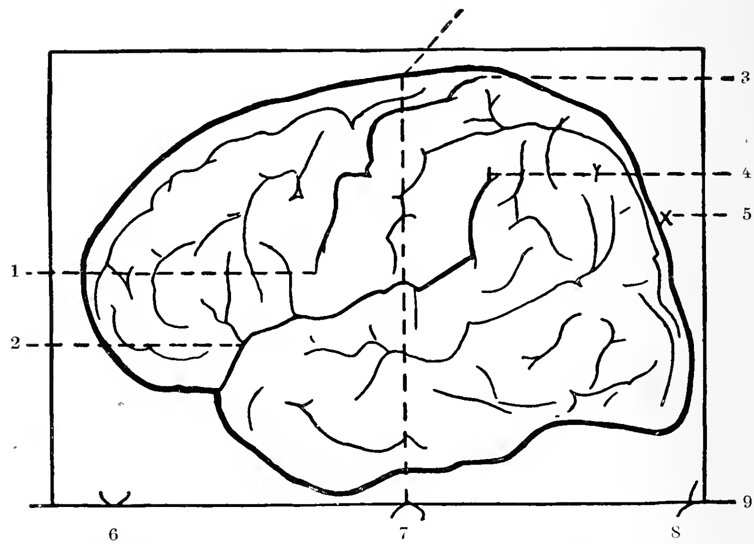


Fig. 228.—Example of Frontipetal Type of Brain. (*Krause.*) 1, Sulcus centralis; 2, Point of division of Fissure Sylvii (Sylvian Point); 3, Sulcus centralis; 4, Fissure of Sylvius (Upper end); 5, Fissure parieto-occipitalis (Lateral end); 6, Rim of orbit; 7, External auditory canal; 8, Prot. Occip. Ext.; 9, German Horizontal line.

cephalic nor dolichocephalic heads need necessarily present the frontipetal or occipitopetal types of brain position." These representations of *Froriep* are of importance to the surgeon, giving us the relative values of each type upon which to base a method of action.

Beyond the various types of skulls other deviations from standard are to be considered, such as race, sex and age. To avoid encumbering elucidation of the problem I proceed at once to a discussion of the most important considerations in connection with the convolutions and fissures of the brain.

1. *The sulcus centralis* (fissure of *Rolando*) generally takes a course in which there are two kneelike bends; its situation, therefore, is only determinable on the calvarium at its upper and lower termina-

tions. The former is located by dividing in one-half the distance between the root of the nose (naison) and the external occipital protuberance (inion) and measuring backward from this 2 cm. (*Thane*, 1 cm.) *Broca* employs for the purpose in addition to the naison, which corresponds to where the nasal suture reaches the frontal bone, the ophryon, which is located at the middle of the glabella. Measuring backward from the ophryon in the median line the upper end of the central fissure is located 53/100 behind the former. (*E. Masse* and *Woolingham*.) The lower end of the fissure corresponds in the

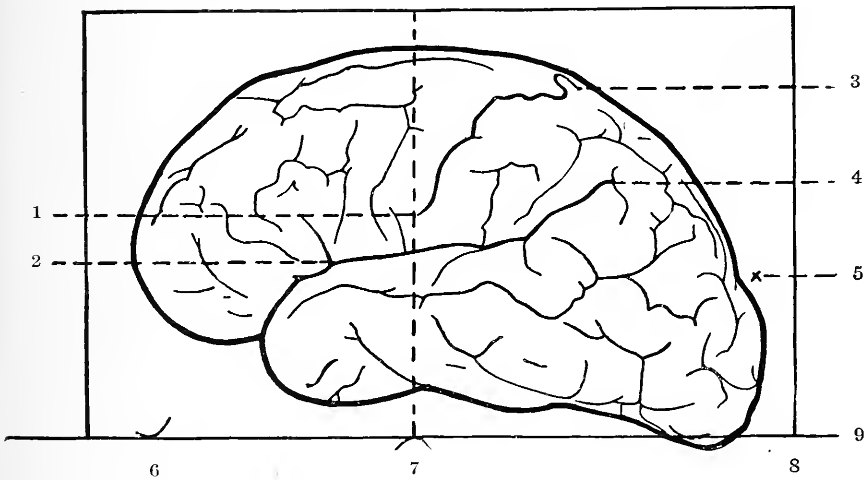


FIG. 229.—EXAMPLE OF OCCIPITO PETALER TYPE OF BRAIN. (*Krause*.) 1, Sulcus centralis; 2, Point of division of Fissure Sylvii (Sylvian Point); 3, Sulcus centralis; 4, Fissure of Sylvius (Upper end); 5, Fissure parieto-occipitalis (Lateral end); 6, Rim of orbit; 7, External auditary canal; 8, Prot. Occip. Ext.; 9, German Horizontal line.

adult to a point determined by dropping a vertical line through the preauricular depression between the tragus and the articular head of the inferior maxilla on the upper edge of the zygoma, and measuring upward on this line 5 to 6 cm. from the upper edge of the external auditory meatus. In children the foot of the fissure is located 15 mm. below the middle of a line drawn vertically from the external auditory meatus to the sagittal line. This line, together with the fissure, forms an angle of 67 degrees. (*Hare*.)

The central fissure lies in the middle of the anterior third of the parietal bone; its lower two-thirds runs nearly parallel to the coronal suture, while the upper one-third deviates sharply backward. The position it occupies is at its lower end 30, at the upper 40 to 50 mm.

from the coronal suture. In women the distances are 27 to 45 mm., and in children 11 to 33 mm. respectively. (*Poirier.*)

As the *gyri centralis anterior* and *posterior* in the adult measure at their middle 18 to 22 mm. in breadth, determination of the situation of the central fissure locates the situation of the precentral and postcentral convolutions.

2. *The Fissure of Sylvius* runs with moderate ascending obliquity from *Brocas'* pterion, which latter is located near the posterior end of the sphenoparietal suture (anterior vertical line 4 to 4½ cm. above the zygoma), to the middle of the lower portion of the parietal tubercle, though it does not in all instances reach quite to the latter point. As the fissure varies in development, and with regard to its upper terminal end also varies considerably as to its course, the designation just stated is somewhat unreliable. In the frontipetal type *Froriep* found the upper end of the fissure more toward the anterior lower portion of the parietal tubercle, and in the occipitopetal type more toward its posterior aspect. In children during the first two years of life the squamous bone is quite small, and the parietal bone reaches to or extends below the first temporal sulcus. In these instances the fissure of *Sylvius* is covered entirely by the parietal bone.

The fissure divides into three branches, *ramus, anterior horizontalis, ramus anterior ascendens* and *ramus posterior horizontalis.* The latter represents as the main branch the greater part of the fissure. The origin of the two anterior branches corresponds to the punctum *Sylvii* (*Sylvian* point of the English), which is located at the pterion. The ramus anterior ascendens lies vertically to the ramus posterior horizontalis; the ramus anterior horizontalis runs from the pterion beneath the sphenoparietal suture with reliable persistence in an anterior direction.

3. The *three frontal convolutions* lie with their posterior ends in contact with the precentral convolution, *i. e.*, about 22 mm. from the central fissure. The first begins 1 cm. from the median line, taking the longitudinal sinus into account. The second is located with its middle (in children, *Fere*) under the center of the frontal eminence, while in the adult this point corresponds to the first frontal fissure or to the border between the inner and outer two-thirds of the second frontal convolutions (*Poirier*). The third is situated about the rami anterior horizontalis and ascendens of the fissure of *Sylvius.*

4. The *three lateral temporal convolutions* occupy the space at the side of the brain between the fissure of *Sylvius* and the temporal border. The latter in the average corresponds to a line 5 mm. above

the upper edge of the external auditory meatus, that is, in this situation, very near the level of the upper border of the zygoma, and at its middle to the incisura semilunaris of the lower jaw, where the lowest point of the temporal lobe is usually found (*A. Froriep*), though it may dip down to opposite the lower edge of the zygoma.

The first temporal convolution measures at its center about 15 mm. in breadth, and is bounded below by the first temporal fissure, which is, because it runs parallel to the fissure of *Sylvius*, at times called the *fissura parallela*. The second, which is rarely strongly apparent, lies about in the middle between the first fissure and the temporal border line.

The anterior two-thirds of the first and second temporal convolutions are covered by the squamous portion of the temporal bone, the extreme front ends by the greater wing of the sphenoid. The anterior portion of the third (and fourth) temporal convolution may be reached from the anterior part of the inferior temporal fossa, which is formed by the greater wing of the sphenoid bone.

All three lateral temporal convolutions end at their posterior aspects in the gyrus angularis and supra marginalis, both of which are most largely formed by the parietal lobes.

5. The location of the *gyrus supramarginalis* corresponds to the situation of the tuberosity of the parietal bone (*Huske*), and winds around the posterior end of the ramus posterior horizontalis of the fissure of *Sylvius*.

6. The *gyrus angularis* winds around the posterior upper end of the first temporal fissure. Its location is determined upon the unopened skull in its relationship to the tuberosity of the parietal bone lying a little behind and above it, *i. e.,* about 3 cm. behind the gyrus supramarginalis. (*Poirier.*)

7. The *sulcus parietalis* (*intraparietal fissure*) consists of two divisions; its ascending branch connects with the retrocentral fissure, and lies about 20 mm. behind the central fissure. (*Waldeyer.*) The longer horizontal branch runs close to the upper portion of the tubercle of the parietal bone, 45 mm. lateral to the median line, and when it reaches to opposite the lambda it approaches to within 33 mm. of the latter. (*Thane.*)

8. The *parieto-occipital fissure,* in the occipitopetal type of skull, lies with its upper end immediately above the lambda (top of the squamous portion of the occipital bone) or corresponds exactly to this point, and in the frontipetal type and in young children, 1 cm. higher up and 2 cm. lateral from the horizontal line. The lambda is, in the adult, located 6 to 7 cm. above the external occipital

protuberance (inion), and 8 to 10 cm. behind the upper end of the *Rolandic* fissure.

Prolongation of the lines KS and KK, of the *Kroenlein* construction to the sagittal line, leaves a space between it and the median line; if this be divided into three parts the parieto-occipital fissure will be found to correspond to about the junction of the middle and upper thirds.

A knowledge of the course of the fissures of *Rolando* and *Sylvius* reveals the location of the central convolutions, the operculum, the temporal lobe and also the seat of the frontal and parietal lobes of the cerebrum. As the external occipital protuberance is palpable in all skulls, the location of the occipital lobe is also readily recognized.

9. The *cerebellum,* with its hemispheres, lies in contact with the squamous portion of the occipital bone, the posterior third of the mastoid process of the temporal bone, and rests with its inferior surface upon the foramen magnum. Upward it reaches to the linea nucha superior, which corresponds to the lower edge of the transverse sinus. "The white substance of the vermis runs on a quite horizontal line to the confluent sinus." (*Waldeyer.*)

10. The *large basal ganglia.* As I have not made any observations and have had no experience in this connection, I quote *Waldeyer* verbatim: "My investigations substantiate on the whole those of *Féré* and *Dana,* but to be exact the three localization levels of these authors should be supplemented by three additional ones. According to Dana a frontal level 18 mm. behind the fronto-zygomatic suture corresponds to the anterior end of the corpus striatum, a second at the posterior border of the base of the mastoid process or the upper end of the fissure of *Rolando* corresponds to posterior knee of the *corpus striatum* or posterior border of the *thalmus.* A horizonal level 45 mm. below the vertex of the cranium skirts the upper surface of the striatum. I add to this that the lower border of the cerebral ganglionic mass corresponds to the naison-horizontal line, its lateral dimensions lying between the middle level and the lateral ventricle.

The anterior horn of the latter, however, lies (according to *Poirier*) at the forehead, 6 to 7 cm. from the scalp, the posterior and inferior horns 4 cm. *Tillaux* states with truth that the basal ganglia, *in toto,* are situated above the external auditory meatus and that this opening corresponds about to their middle.

Between the levels mentioned the island of *Reil* is situated, for the exact localization of which additional guides are necessary. *G. D. Thane* locates the pole of the island at the punctum *Sylvii.* A point on the linea *Sylvii* 35 mm. behind this indicates the posterior end of

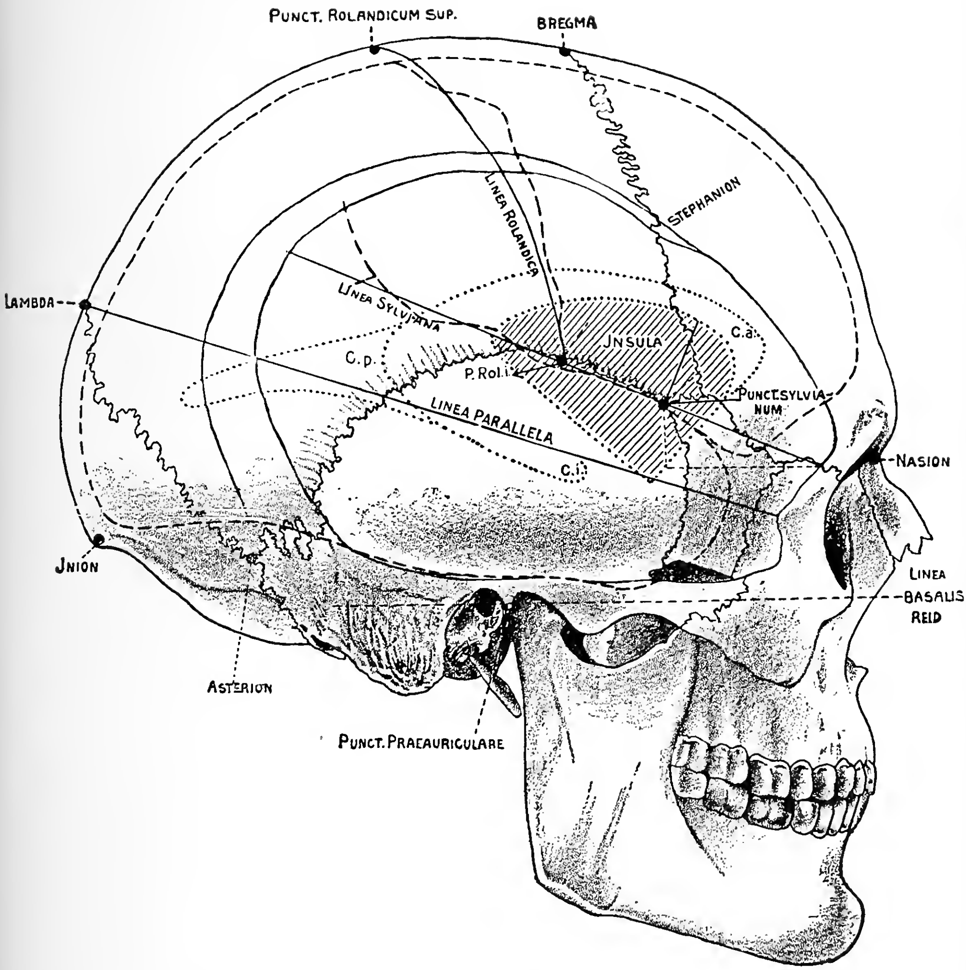


FIG. 230.—LOCATION OF THE INSULA AND LATERAL VENTRICLE. ISLAND OF *Reil*. The Punctum *Sylvii* designates the pole of the island, its posterior end lies on the linea *Sylvii* 35 mm. behind this point. The shaded outline of the island acts as a guide to the basal ganglia, which extend only slightly beyond it, about to the outer border of the main portion of the lateral ventricle. The lateral ventricle is outlined by a dotted line, its three horns (anterior, posterior and inferior) are also indicated in the same way. The fissure of *Rolando* and *Sylvius* is indicated with broken lines. *Reid's* base line (horizontal line of the skull) is the *Frankfurter Linie* of the German anthropologists. It begins at the lowest point of the inferior edge of the orbital cavity and crosses at the highest point of the upper edge of the external auditory meatus. (*Krause.*)

the island, and the anterior end lies 15 mm. in front of the punctum *Sylvii.* The upper border runs from behind in a curve through the upper end of the ramus ascendens anterior sylvii to the anterior upper end, the lower from the posterior end to a point 15 mm. forward from the punctum *Sylvii* on the linea zygomatico-lambdoidea, the anterior border being outlined by the union of the two anterior end points mentioned. (Fig. 230, *Krause.*)

For the purpose, the scalp is shaved and cleansed in the manner stated above. The physician supplies himself with a diagram of the necessary measurements, and after placing the patient in a comfortable position proceeds to indicate the fissures mentioned. This is the more accurately done by the physician in charge of the case, who has had the patient under observation for some time and has had ample opportunity to arrive at a conclusion as to what particular type of skull formation is being dealt with. The outlines of the fissure are marked with the ordinary nitrate of silver stick, which is moistened with water when the demarcation is being made. The scalp should not be moistened and the silver pencil then applied, for the reason that the excess of water will cause the silver solution to "run," streaking the contiguous skin and giving rise to confusion as to the exact location of the fissures, at the time of the operation. Especially is this to be borne in mind, since faulty streaking does not become apparent until several hours after application of the silver stick, the silver salt not becoming black until oxidized.

The illustration (Fig. 226) shows only the *Sylvian* and *Rolandic* fissures outlined, and, indeed, these are the two most important guides necessary to cranial operations. However, additional fissures and sulci may be outlined in cases which involve invasion of other than the motor areas, in the same way.

CARE OF WOUNDS OF CRANIAL BONES

Resection of the cranial bones either for removal of diseased bone or for the purpose of attacking the cranial contents is invariably followed by drainage, the drainage agent being modified in accord with the character of the process for which relief is undertaken. As a rule, textile fabric drainage will be found the most useful. Tuberculosis of cranial bones, suppurative osteomyelitis, osteitis, etc., when attacked surgically, are always followed by drainage.

The removal of gumma, osteosarcoma and aneurism of the diploe do not present urgent indications for the employment of drainage. However, when there is much trauma to the bone, and if the sectioning of the bone be attended with considerable oozing of blood, provision should be made for egress of secretions by the introduction of silk-worm gut or horsehair drainage. The exudate following operations of this sort will accumulate in the subdural space if this precaution be not taken, and in some instances is sufficiently great in quantity to cause cerebral pressure and its attendant symptoms.

The drainage need not be maintained for more than from three to five days, and will not interfere very much with a favorable ultimate outcome as far as the wound is concerned. Indeed, it may be said that drainage should be employed in all cases involving invasion of the cranial cavity.

Infected wounds of the scalp and cranial bones should be dressed every forty-eight hours. The protective dressing should consist of wet gauze, the gauze being saturated with a solution of corrosive sublimate 1 in 2,000. It conserves drainage to fluff the gauze (Fig. 188, page 223). Capillarity is enhanced and cleanliness conserved in this way. The gauze may be covered with rubber tissue or oiled silk to maintain, as long as possible, the moisture, and prevent soiling of the bedclothes from contact with the wet dressing. Prolonged application of carbolic acid solutions may cause gangrene, and this agent should not be used for the purpose. Cleansing of the wound at each sitting should be made, with ample provision for free discharge of the cleansing agent. Hydrogen peroxid especially calls for precautions in this regard.

It is easy to see how the bubbling peroxid of hydrogen might convey infective material into heretofore uninvaded areas if care be not exercised to provide for its ready egress. This is most important in connection with wounds involving the aponeurosis, and especially so if the bone and dura mater have been sectioned. When the latter has been opened, the entrance of infective substances between it and the pia may lead to exceedingly dangerous complications, the infection extending into the meshes of the arachnoid to the pia and to the brain cranial contents.

OPERATIONS INVOLVING CRANIAL CONTENTS

Operations involving invasion of the cerebral membranes and the cranial contents present certain problems, the outcome of complication, which do not have the same import in other portions of the body.

During all operations upon the brain care must be exercised to avoid undue pressure upon the thorax and abdomen which might interfere with respiration. The top of the table should be arranged to allow of change of position on its transverse axis, so as to make it feasible to raise the head of the patient if venous bleeding be excessive (*V. Bergmann*) or to lower the same in the event of syncope. The operating room should be warm (24°-28° C.). Beyond this I lay the patient upon warm pads at the temperature of the body, and wrap the entire body in woolen blankets.

For operations on the cerebrum, the patient is postured with the shoulders and thorax raised to a little less than 45 degrees. If the posterior portion of the head rests on the pad, *i. e.,* when the anterior portion of the skull is being invaded, the portion of the table upon which the pelvis rests is lowered a little while the upper body is caused to rise obliquely. This position is very secure. In operating on the side or posterior aspect of the head it is best to posture the patient on his side and allow the head to extend beyond the edge of the table. In all instances an assistant holds the head firmly with the fingers apposed to the jaw and cheeks.

When opening the posterior cranial fossa the patient may be placed on the sound side in such a manner as to bring the shoulder on a level with the edge of the table, a posture which makes readily approachable the area of operation. The head is held by an assistant, or, better still, may rest on the head supporter. In the case of fat persons or those who have short necks, this posture does not give sufficient room, and I employ it, as a rule, only for the first step of the trephining, although I have removed tumors of the acusticus on two occasions with the patient in this position.

As a rule the operator finds it convenient to be seated when invading the cerebellum. The head of the table is lowered slightly; head and shoulders are permitted to extend somewhat beyond the back support, so as to permit of ready approach beneath the posterior occipital protuberance. The assistant holding the head turns it sidewise or bends it forward, as the necessities demand. An assistant is detailed to watch the pulse and respiration. The regions of the medulla oblongata, with the centers of respiration and that of the heart, are likely to be disturbed, indeed, twice I was compelled to interrupt the operation for from ten to fifteen minutes to permit of reëstablishment of function in this connection. The patient reacted very nicely; however, had the pulse and respiration not been closely observed a fatal issue on the table would no doubt have been the outcome. (*Krause.*)

In instances where operation is undertaken for relief of infectious processes within the skull, dura, and brain, drainage is maintained for a long time, indeed, until all evidence of infection has disappeared. It is best to err on the side of conservatism in this connection and prolongation of the drainage, to this end, is not to be regarded as over caution.

The more modern and most generally employed method of approach to the contents of the cranial cavity involves saving of the bone, unless the intracranial affliction involves by extension the bone itself. In these instances, as obtains with tuberculosis, gumma, and malignant disease, the bone must be sacrificed.

In operations involving the cranial contents where infection does not exist, drainage of the superficial wound is usually established and left *in situ* for four or five days. By this time the question of infection will be quite settled, and if none has appeared, the drainage agent may be removed. If the cavity in the brain tissue resulting from removal of a diseased process has also been packed with gauze, this, too, should be removed at the same sitting. A smaller portion of gauze may now be placed in the brain cavity through the wound of egress of the two drains removed, and this will act as a drain for both the deep and superficial areas.

It is to be remembered that the trauma to the bone consequent to osteoplastic resection may cause superficial necrosis of the edges of the flap or the opposite edge of the bone. The inferior angle of the bone may, therefore, be kept open for a time after the drains have been removed, with the view of encouraging discharge of the detritis through this avenue. This is accomplished by placing a small horsehair or silk-worm gut drain into the point of exit of the gauze drains. As a rule, gauze drainage in clean cases need not be maintained for more than ten days after the operation.

The posture of patients after operations on the cranium, its coverings, and contents, after the shock has disappeared, should contemplate lessening of the quantity of blood in that region and gravitation of the cerebrospinal fluid away from the ventricles. The head of the bed should, therefore, be raised. However, if the operation has been done with the view to facilitating discharge of the fluid in order to lessen intracranial pressure, as obtains in the decompression operations intended for the relief of hydrocephalus internus, the discharge of fluid is enhanced by lowering the head of the patient. Discharge of cerebrospinal fluid calls for additional precautions. The quantity discharged in twenty-four hours is at times amazingly large, and the fluid saturates the dressings in a few hours. Under these circumstances, it is difficult to maintain asepsis. Close attention to detail has succeeded in preventing infection for several months in a certain number of instances, but this outcome was attained only as the result of painstaking effort. The general condition of the patient depends much upon whether the discharge of cerebrospinal fluid is free or not. This applies, of course, to cases in which the cause of increase of intracranial pressure has not been removed at the operation. Cessation of the flow is usually attended with restlessness, headache, paralysis, and subconsciousness, in the order mentioned. In these instances inspection will probably reveal interference with drainage.

The establishment of permanent drainage is not properly discussed here. During the care of postoperative cerebral prolapse, when pressure is being made to reduce the protrusion, return to the normal is facilitated by permitting the patient to assume the sitting posture if there is no distinct indication to the contrary. Indeed, if the general condition of the patient permits, the pressure, as described farther on, should be made while the patient is sitting. As a rule, drainage of the cranial wound is made from its most dependent portion, and the posture of the patient should take cognizance of this with regard to both the supine and sitting positions.

Patients who have been subjected to operative attack in this region of the body are frequently subconscious or entirely insensible. Especial care must, therefore, be exercised with respect to the excretions. Involuntary discharge of feces and urine must be balanced by scrupulous attention to cleanliness, and the bed linen should be frequently changed. Again, when sensation is impaired as the outcome of central lesions, bed sores are likely to occur, and it is a wise plan to place these patients upon a water bed immediately after the operation, and the attendant must be admonished to frequently change the posture of the patient and to sponge the skin often with alcohol to obviate pressure necrosis and its consequences.

The diet does not differ in these cases from that usually employed in postoperative care. It may, however, be said that alcohol is probably best omitted for obvious reasons. The character of dressings applied to the scalp does not differ from that described in connection with the care of wounds generally.

In instances of operations on the cranium which involve invasion of the brain the problem is somewhat different. Contact of antiseptic gauze with the wound itself should be avoided in clean cases. However, the fact, as already stated, that large quantities of cerebrospinal fluid are discharged from wounds of this sort, and that infection may thus gain access to the site of surgical trauma, suggests that the outer layer of gauze would be well saturated with some antiseptic. For the purpose 5 per cent. iodoform gauze answers very well, though its use is somewhat objectionable on the score of its offensive odor. Gauze soaked in corrosive sublimate may be used. However, a certain capillarity exists in both directions, and prolonged contact of corrosive sublimate solution with the skin causes dermatitis. It is best to use the corrosive sublimate gauze dry and change it sufficiently frequently to obviate its penetration to the wound surface. This will vary in accord with the amount of cerebrospinal fluid discharged. It is probable that a change of the outer dressing twice daily will suffice the contingencies.

When the operative procedure is divided into two stages, as is frequently the case in large neoplasms of the brain, the sutures temporarily holding the parts in position should be removed on the fourth day following the operation, with the view of preventing the occurrence of small necrotic areas at the site of the sutures which favor local infection. Infection in the superficial wound would necessitate postponement of the final measure of relief until it has been controlled, an occurrence which might be objectionable, should urgent symptoms suddenly develop in the case calling for immediate invasion of the brain tissue.

BONE NECROSIS

With respect to bone necrosis following operations on the skull, *Krause* says:

If separation of the periosteum is avoided necrosis of the bone rarely occurs in aseptic cases. Bone necrosis is very likely to occur if the periosteum is widely separated at the edges of the flap, and especially is it liable to occur in purulent processes. In the latter cases the cavity is tamponed and this causes interference with nutrition in the bone. Owing to the consistence and thickness of the cranial vault demarcation and separation of necrotic bone areas is a prolonged process, and this together with carious degeneration of the edges of the bone sections may be maintained for months before ultimate healing takes place. No general rule as to whether removal of the diseased bone is indicated may be given the reader for guidance.

Early in my experience I had two cases in which extensive necrosis of bone occurred. Both cases were operated upon for removal of the ganglion of *Gasser* by my own osteoplastic flap method at the temporal region. The one case was one of one-sided resection of the ganglion, the osteoplastic temporal flap being fashioned with the circular saw. (August 23, 1895.) The patient had been subjected to peripheral trifacial resection at which time a certain degree of hemophilia was discovered. Owing to the severe and persistent bleeding at the time of the intracranial neurectomy the operation lasted three hours. The prolonged hemostatic manipulations subjected the flap to considerable trauma and the periosteum was largely separated from the bone. Replacement of the flap was nevertheless made. The other case (the second attempt of the kind made by myself in 1892), that of a man, aged sixty-two, the intracranial resection of the second branch of the nerve required chiseling of the bone. The operation was performed on both sides at the same time, and owing to the enfeebled general condition of the patient the second wound was tamponed for five days before resection of the ganglion was undertaken. The consequent prolonged interference with nutrition resulted in necrosis.

In these two cases the bone necrosis was not accompanied by fever. The process expressed itself in an edematous swelling of the skin flap and adjacent tissues together with puffiness of the lower eyelid. On the tenth day the wound was opened and the bone flap removed. The excised bone showed a thin layer of fibrinous pus on its inner surface. The scalp flap was replaced and sutured, and drainage introduced into the two lower angles of the wound. A small amount of purulent discharge accompanied the healing, which latter was achieved without rise of temperature.

Exfoliation of small portions from the edges of the bone flap occurred in two other cases under my observation. In neither case was interference called for. The necrotic bone was eliminated in the form of fluid discharge. The process was exceedingly protracted, the fistulæ remaining patent for eight and ten months respectively. To prevent occurrences of this sort the edges of the bone flap which have been denuded of periosteum should be removed with the biting forceps.

SECONDARY HEMORRHAGE

The occurrence of moderate bleeding following operations upon the brain is attended with quite radical modification of the clinical picture, and if not relieved may lead to a fatal outcome. This may be illustrated by quoting a case of the sort from *Krause*. The patient, a merchant aged twenty-three, who presented the symptoms of cerebellar tumor, was subjected to osteoplastic resection of the skull. *Krause* relates the following:

After opening the posterior cranial fossa a cyst was incised, and the cavity tamponed with vioform gauze. At the end of five days the tampon and the drain was removed at which time no fluid secretion was discharged. During the few days following the operation the marked symptoms of cerebral compression had disappeared and the less manifest symptoms had much improved; however, four days later the evidence of cerebral compression again appeared. When the dressing was removed a large quantity of clear fluid poured from the lower right angle of the wound. The osteoplastic flap manifested definite pulsation. Despite this fact, the compression symptoms did not diminish, the temperature rose in the evening to 39.5 and 40.0. There was no rigidity of the neck, but dysphagia and subconsciousness rapidly developed. For these reasons I felt justified in opening two days later (eleven days after incising the cyst) the entire wound. Clear fluid dripped constantly from the lower left corner of the wound, and the osteoplastic flap, which had quite advanced toward repair, pulsated visibly. While the skin was being shaved and cleansed with ether a rather forcible stream of clear fluid bubbled out of a grayish granulating area located at the center of the wound (about 20 cm. in quantity). However, I regarded it as proper to expose the entire operation field in view of the patient's menacing general condition. The osteoplastic flap was rapidly turned down with the closed scissors.

The exposed cerebellum appeared normal, its surface was smooth and shining and of the same color as at the previous operation. There was no swelling, softening, necrosis or pus present. The only abnormality presented on the surface of the left cerebellar lobe in the form of a slightly protruding area the size of the distal phalanx of the thumb which was dark blue in color and corresponded to the site of the cyst opened at the previous sitting. The incision into the cerebellum had quite healed but was now bluntly separated, exposing a cavity the size of a plum which was tensely filled with coagulated blood. This was gently expressed and the cavity tamponed with vioform gauze. The osteoplastic flap was sutured into its original position. The following day the more marked symptoms of compression disappeared. The tampon was removed on the fourth day, and two days later the sutures were removed.

The disturbance was evidently due to the fact that after the tampon had been removed (five days after the operation) the cerebellar wound became glued together, and bleeding occurred from the not yet obliterated vessels in the cyst wall which distended the cavity. The coagulum, acting like a tumor and together with the retained fluid, provoked the symptoms of compression. After the second operation recovery went on to completion without interruption which was still maintained at the end of a year and a half.

In two cases of cortical excision for *Jacksonian* epilepsy it was necessary to reopen the operation wound because of blood and fluid collections which produced menacing compression symptoms. The first case was that of a man, aged thirty years, who was subjected to cortical excision on October 15, 1902, after locating the primary spasm area with the faradic battery in the forearm, hand and face centers. The operation did not make any serious impression on the patient's general condition. The pulse was regular, quite full and strong (80). The immediate course was favorable, the drain and gauze strip being removed on the fourth day and the sutures three days later. The temperature reached 37.8 at the end of thirty hours, and fluctuated in the neighborhood of 37.0 until the eighth day, when it rose to 38.7 degrees. The evening of the day of operation the pulse rose to 128 but slowly dropped to 92. Simultaneously with the increase of temperature the pulse rose again to 128. There was no evidence of meningitis, and the wound was healed except for the drainage openings.

The patient became subconscious and complained of bladder tenesmus. Radiating pains in the thigh developed and the entire right leg was markedly weaker than it had been during the latter few days. The muscles of the thigh were contracted. The evidence of irritation pointed to a focus in the leg center. On October 23d, under chloroform narcosis, I opened the entire wound, which required the knife for the purpose, owing to the firm union already established, and turned aside the osteoplastic and dural flaps. We found a brownish red firmly coagulated clot lying on the surface of the brain at the upper portion of the exposed field by the side of which clear fluid oozed out. When this was removed the corresponding surface of the brain glistened, but was slightly infiltrated with bloody exudate. A few strips of iodoform gauze were laid on the involved area and the dural and bone flaps replaced after a small drain had been introduced. The next day the temperature fell to 37.9 degrees, and the following day to 37 degrees. The pulse dropped to 104. Restlessness and the other symptoms disappeared. Repair of the wound occurred without further complications. The tamponade was renewed with sterile gauze every three days and continued for fourteen days (until November 7th), at which time the bone was pushed into the space in the skull. As hernia cerebri did not develop the bone healed into place without disturbing the normal outline of the skull. On December 29th the patient was discharged.

RETENTION OF CEREBROSPINAL FLUID

The influence of retained cerebrospinal fluid is a complication arising subsequent to surgical attack upon the brain, which leads to much the same train of symptoms related in *Krause's* case of secondary hemorrhage. The inference is when symptoms of this sort occur that either the drainage has been interfered with, or that drainage was indicated in cases where it was not employed. This condition of affairs is most likely to occur in connection with the postoperative picture following cases in which the intracranial pressure has for a long time been abnormally high, and relief immediately following the operation is, in a measure, due to relief of tension.

However, the fact that the retension of cerebrospinal fluid may give rise to symptoms when there has not been an abnormally high intracranial pressure is illustrated in the history of the case here submitted, which was subjected to trephining for relief from epilepsy.

The patient, a feeble boy, aged twelve years, had quite overcome the effects of excision of the hand center. The temperature had risen once, on the evening of the day of the operation, to 38.5, the pulse to

136. On the second day the record showed temperature 37.5, pulse, 96. Despite this the patient at this time became restless and vomited persistently, although he had quickly recovered from the effects of chloroform after the first operation. There was no interference with the movements of the head, and indeed, he showed no symptoms of meningitis. His appearance was unfavorable and the general condition so enfeebled that he did not retain the smallest nutritive enema. As the conditions continued to grow more menacing and endangered life, I lifted, on the third day after the operation (October 27, 1907), the large osteoplastic flap (60-80 mm.) and the dural flap (50-78 mm.) emptying out a small quantity of coagulum and a large amount of cerebrospinal fluid. After the introduction of vioform gauze the dura and superficial flap were replaced without suture. The next day the patient retained a soft boiled egg and four rectal injections of 100 cm. each. The color of the face improved and was no longer greenish yellow, as it had been the day before. Improvement continued with slight fluctuations. On October 30th the flaps were again lifted and the gauze removed. At the site of the cortical excision a single strip of gauze was introduced which was removed on November 2d. The dressing continued to be saturated with cerebrospinal fluid until November 16th. The flap was not sutured, but nevertheless healed in place on the level with the contiguous skull without any residual bulging. On November 29th the boy was discharged, in perfect physical and mental health. Six months later the patient reported in perfect health.

EDEMA AND SOFTENING OF THE BRAIN SUBSTANCE

Edema and softening of the brain substance may occur, even in aspetic cases, in the region of the operative field.

These changes are, as regards intensity, primarily dependent upon the extent of surgical trauma. If the operation be restricted to simple cortical excision for *Jacksonian* epilepsy, the more or less extensive paralysis immediately following the operation disappears at the end of a few days. The characteristic disturbances dependent upon removal of a certain motor center, however, remain. If traumatic degeneration develop in the contiguous brain tissue additional paralysis appear, which are dependent upon involvement of adjacent foci. The process is not necessarily accompanied by systematic manifestations. The symptoms of edema and softening appear usually, if at all (which is not frequently the case), about a week following the operation, and disappear in a short time.

Following removal of tumors the process is likely to be quite extensive, the outcome of severe trauma to the brain substance. The cause of these encephalitic, edematous softening processes as they may be designated, may be explained as follows. The growth of the tumor has exercised a harmful pressure upon the invaded brain tissue, the extirpation has necessitated division of blood vessels which also has robbed the surrounding parts of nutrition. Division of nerve fibers always provokes edematous saturation and swelling in the region of the trauma, as has been observed in the peripheral nervous system. All these factors aided, perhaps, by small hemorrhages cause a condition of softening, which, in the majority of cases of aseptic operations, is limited to the immediate neighborhood of the operative field and does no great harm. On the other hand the process may extend and lead to a fatal outcome, as shown in the following instance.

The patient, a laborer, aged forty-four, was subjected to operation March 15, 1904. I removed a cortical glioma from the lower portion of the anterior central convolution after deligating the approaching veins, exercising an area 35-39 mm. in diameter and 20 mm. in depth. The wound in the brain was covered with vioform gauze, over which the dural flap was laid. The osteoplastic flap was replaced and held with sutures except for a small area.

The dressing was changed on March 21st. The wound was healthy and the gauze strips were removed. The general condition of the patient was satisfactory. On March 29th the scar was normal, but a pulsating prolapse the size of a walnut protruded from the anterior inferior angle of the incision. The patient stated that on this day the movements of the right leg were less certain and weaker than immediately after the operation. On April 12th the prolapse appeared considerably flatter. The general condition remained good. Appetite and intestinal functions were normal, however, the patient complained of intermittent headache. From the 29th of March, on the right lower extremity showed paretic symptoms. On April 4th clonic spasm of the quadriceps appeared. The asphasic disturbances which had followed immediately after the operation became more marked, though the psychic functions remained normal. The conditions in the trephine wound continued to improve. On April 20th the still decreasing prolapse showed signs of dermatisation and by April 26th the hernia had receded to the level of the surrounding skin.

However, the general condition of the patient became worse, vomiting occurred once. In the next few days the vomiting increased and the paralysis increased, though no spasm occurred. Beyond the headache no symptoms of brain pressure developed. Choked disk did not appear. After the 29th of April the patient did not speak except to answer questions; urine and feces were passed involuntarily. The next day the general condition was slightly better. From May 1st on matters took on a worse form, the left side of the body became paralyzed and deglutition became difficult. Up to this time the pulse remained below 76 and the temperature normal. May 2d the pulse was 98 in the morning and 110 in the evening, respiration 28 to 30. Death supervened on the morning of May 3d after paralytic and bronchopneumonic symptoms appeared. Vomiting and convulsions did not recur.

Autopsy showed the surface of the brain richly covered with thick veins which quite effectually obscured the fissures. The sagittal end of the left fissure of *Rolando* corresponded to a point 4 cm. in front of the posterior pole of the left cerebral hemisphere, which latter measured, from its anterior to its posterior aspects, 19 cm. The fis-

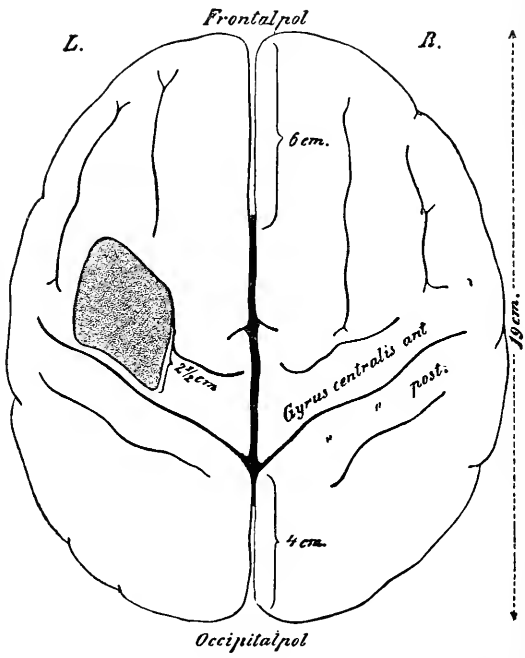


FIG. 231.—AREA OF CEREBRAL SOFTENING. (*Krause.*)

sure of *Rolando* met at the point designated the longitudinal fissure. Two and a half centimeters inferior to this point the anterior central convolution presented a defect which corresponded to the site of operation (Fig. 231). The contiguous convolutions were slightly tinged with yellow. The irregular anterior border of the defect encroached upon the frontal convolutions. Frontal section disclosed beyond the defect mentioned the fact that the greater part of the left cerebral hemisphere was infiltrated with dark red and black hemorrhages (Fig. 232), which extended toward the median line to near the longitudinal fissure and downward to the level of the fissure of *Sylvius,* involving, however, only the white substance. The gray matter was not invaded, the crux was not involved, and the process had extended between the cerebral peduncles and the optic thalma, leaving the basal ganglia unaffected.

FIG. 232.—AREA OF CEREBRAL SOFTENING. (*Krause.*)

It was evident that the bleeding had begun beneath the fissure of *Rolando* and extended throughout the entire left hemisphere, involving an area of 11 cm. Judging from the anatomical and microscopical findings death had been caused by hemorrhage and softening.

In some instances a fortunate discharge of degenerated brain substance occurs and the threatening symptoms disappear. This is illustrated by the following case: A woman, aged thirty-seven, had been subjected to removal of a fibrosarcoma, the size of a mandarin, from the left island of *Reil.* At the end of twelve days following the enucleation, a quite complete paralysis of the opposite arm occurred, which was followed by paresis of the lower portion of the face and muscular weakness of the leg a few days later. The aphasia which had improved after the operation became again manifest, speech disappearing entirely. The involvement of motor centers contiguous to the site of removal of the tumor justified the belief that the cause of the paralysis was either an edema or softening of the respective foci in the central region. In addition, the patient showed some evidence of irritation, headache, pain in the wound, and increased pulse rate (100). Though the temperature did not rise sharply the remissions were more marked than had previously obtained. The consciousness was dull, though this cleared up in a few days. The paralysis, however, remained for several weeks and gradually cleared up entirely while speech returned but slowly. During this time the drainage opening discharged at first large quantities of serous secretion together with disintegrated particles of brain substance, which gradually lessened in amount.

This observation would seem to teach that a policy of non-interference together with close espionage of the manifestations is justifiable. Every attack upon the brain, indeed, the comparatively simple reopening of the osteoplastic wound involves additional trauma to and pressure upon the brain substance, which may cause softening. On the other hand the discharge of disintegrated brain substance was manifestly of benefit in this case. Much experience and some good fortune are requisite to enable the observer to determine what is best in a given case.

This sort of superficial necrosis of brain substance contiguous to tumors has been but rarely encountered by the writer. They are not of importance, and will be discharged spontaneously provided the avenue of egress be of sufficient dimensions. A secondary operation may, however, be requisite if the necrosis occur beneath a healed trephine opening, and the process have not created a mode of egress at some distant part. In the case just mentioned the trephine wound had healed except for a small opening at the lower anterior angle of the wound, where the end of the gauze tampon had emerged. At this place a fistula remained, which did not heal despite the cessation of the discharge of brain substance and a small thin drainage tube was inserted. Removal of the drainage tube was followed in a few hours by clonic contraction of the muscles of the opposite side of the face and hand and forearm. At the same time the patient who, up to this time, had been entirely free from symptoms, became restless and complained of headache, which originated from the site of the trephine opening. When the drain was re-inserted a few drops of thin fluid pus were discharged, and the symptoms promptly disappeared. As the conditions did not improve, and each attempt at discontinuance of the drainage was followed by recurrence of the symptoms stated, it was concluded that a necrosis existed in the direction of the drainage which was located obliquely backward and upward under the bone flap. The drain entered the area to 1½ cm. from its point of exit at the anterior border of the wound.

Several weeks after extirpating the tumor I exposed the bone in the direction of the drain with an oblique incision, and made an opening in the corresponding portion of the bone flap with the burr the size of a silver quarter of a dollar. The bone was normal in appearance. The opening exposed at once the grayish red brain, which was covered with blood vessels of the arachnoid and pia. (The dura had been removed at the time of the operation of extirpation.) Immediately below and beside this normal brain area a surface the size of a finger nail and of bluish yellow color presented, which was evidently a thin layer of necrotic brain tissue. The sound introduced through the drainage opening reached this spot. The necrotic area was excised, using the sound as a guide, and the latter pushed through making a counter opening for drainage at the posterior aspect of the original trephine wound. There was no exudate present. Introduction of a drain behind and tamponade with vioform gauze of the wound ended the operation which healed by granulation in a few weeks.

It is evident that the spontaneous discharge of brain substance had not resulted in removal of all of the necrotic area. The trephine wound had healed posteriorly and the resisting osteoplastic flap prevented complete separation and discharge of the dead tissue. The fistula, which was 5 cm. long, was too narrow for the purpose, and only after a free avenue of approach had been made behind did the latter heal. If the technic employed would not have accomplished the desired end, it would have been necessary to split the bony roof of the fistulous tract with the *Giglia* saw or excise a narrow strip with the *Dahlgren* forceps.

DISCHARGE OF CEREBROSPINAL FLUID

Cerebrospinal fluid constantly trickles from the surface of brain prolapse in considerable quantity and especially so from the site of the wound in the brain itself, saturating the dressings quite rapidly. In one case of exploratory incision into the motor zone, which disclosed a tumor of inoperable dimensions, the subsequent discharge of cerebrospinal fluid was so large in quantity as to arouse the suspicion that the lateral ventricle had been invaded. The autopsy performed several months later proved the contrary.

At times the amount of cerebrospinal fluid discharge bears a relationship to the size of the hernia. I have observed variations in this connection in two instances of trephining for removal of neoplasms which proved inoperable. If the discharge of fluid was free the hernia became perceptibly smaller and less tense. This always occurred when large quantities of clear fluid had been thrown off for several consecutive days. As the lateral ventricle had not been opened in either instance it seems fair to assume that at these times the edema had been relieved by the discharge of fluid.

(The outflow of cerebrospinal fluid may not occur even if large openings be made in the dura, if there be no increase of intracranial pressure at the time of the operation. In any event the loss of cerebrospinal fluid ceases very soon if the wound is sutured. For this reason immediate repair of the wound is desirable. Under these conditions the dressing remains dry and need not be changed until healing takes place.

The loss of considerable quantities of cerebrospinal fluid influences to some extent the condition of the patient. Patients complain of headache, especially marked at the posterior aspect of the cranium, feel weak, are apt to hold the neck rigid, though no other symptoms of meningeal irritation appear. Considerable rise of temperature frequently accompanies the symptoms just related. When the discharge of fluid lessens in quantity the symptoms promptly disappear. I have also observed these manifestations (minus rise of temperature), in some cases after extirpation of the ganglion of *Gasser,* when the dura has been torn while separating the upper surface of the ganglion because of firm adherence to the former. In these instances the brain itself is not invaded and the contention with regard to the influence of loss of cerebrospinal fluid is better proved than in operations on the brain.

On the other hand, the well-being of the patient depends upon maintaining the outflow of cerebrospinal fluid as shown in cases operated upon for hydrocephalus. In these cases arrest of the outflow gives rise to headache and other disturbances. In this connection I may state that considerable rise of temperature occurs when the dressing becomes dry.

If for any reason infection occurs, the trephine wound must be at once freely opened. The entire diseased brain area must be exposed in order to determine the necessity for incising the brain, enlarging the opening in the bone or of splitting the dura. All dead spaces should be lightly packed with sterile iodoform gauze and drainage strips introduced. The wound should be kept open until healthy granulations appear. (*Krause.*)

BRAIN PROLAPSE

Sacrifice of the bone, when the pia mater is sectioned at the same time, usually means cerebral prolapse, as a postoperative complication. The size and persistence of prolapse depend upon whether the operative measure has relieved the intracranial pressure, though at times cerebral extrusion occurs when the pressure is not above the normal. Indeed, prolapse may occur when the bone has not been sacrificed, as is shown in the case depicted here (Figs. 233-234).

Fig. 233.—Cerebral Prolapse Following Osteo-plastic Resection of the Skull for Abscess of the Brain.

These illustrations were taken from a case of subcortical abscess of the motor region situated beneath the arm and leg centers. The hernia forced the osteoplastic flap upward and displaced it downward as shown in the illustration (Fig. 234). The denuded area of bone is the portion fashioned into a flap at the time of the operation. The bone, which was separated from the skin and periosteal flap by the progressive growth of the protrusion, necrosed and was removed.

The illustrations show the condition of affairs six weeks after the operation. A large portion of the extrusion sloughed, and separation of the necrotic tissue was effected by patiently removing separated portions at each dressing. The procedure indulged

FIG. 234.—SAME AS FIG. 233. SHOWING BONE FLAP ELEVATED BY PROTRUSION OF PROLAPSE.

in in this instance may be regarded as indicative of what is generally to be done in these cases.

No attempt was made to cut away the prolapse. As *Krause* says, " each trauma to the cortex of the brain, in situations which possess important functions, is attended with paralysis, and should be avoided when feasible."

When the extrusion is cut away it reappears promptly, and each application of the cautery or escharotic is followed by new protrusion.

The prolapse is but sparsely supplied with nourishment, and after a time spontaneous sloughing takes place to a considerable extent. During this time the wound must be kept as clean as is feasible, and ample drainage provided for. The dressings should be changed twice daily and sloughing areas removed with thumb forceps or by the gentle use of the curet. Bleeding may be controlled by gauze sponge pressure. Nature will do much in these cases if given reasonable aid. The reëstablishment of the balance of pressure is also of assistance in ultimate repair. When the sloughing has ceased and healthy granulations cover the mass, a surprising reduction in size of the prolapse will be found to have taken place.

The hair should not be permitted to grow to the extent shown in the accompanying illustrations. On the other hand, during the time that the sloughing is going on it is not wise to subject the patient to the annoyance of keeping the scalp shaved all the time. Once a week or at ten-day intervals will suffice. When the wound

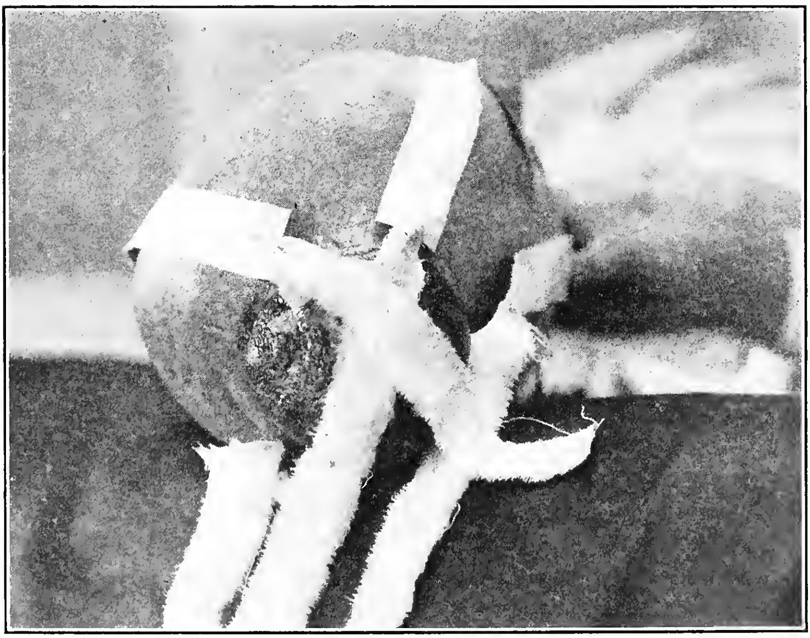


Fig. 235.—Adhesive Plaster Strips and Gauze Tapes for Pressure on Cerebral Prolapse.

surface is clean, the scalp may be kept shaved in order to permit of the application of pressure. This may be attained by applying a firm bandage over the dressings. However, patients complain of the tightness of the bandage at the base of the dressing, and the presence of the gauze renders pressure on the protrusion itself less effective than is desirable.

Pressure is effectually attained by fastening strips of adhesive plaster to the contiguous scalp, at the central ends of which rather broad tapes are attached (Fig. 235). A flat, thick pad of gauze is now placed upon the prolapse and the tapes tied over this,

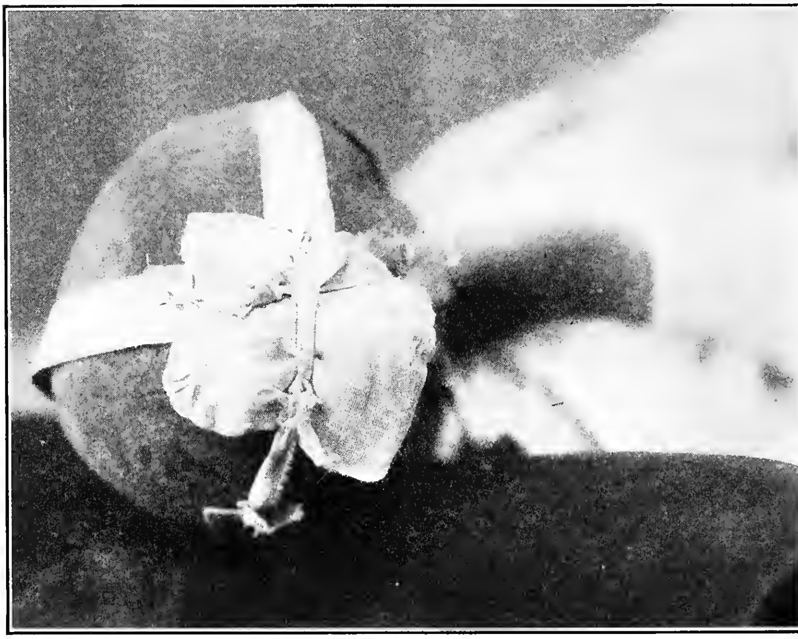


FIG. 236.—GAUZE PAD APPLIED TO CEREBRAL PROLAPSE. PRESSURE MADE BY TYING GAUZE STRIPS IN PLACE.

making the required amount of pressure (Fig. 236). The degree of pressure may be standardized by the behavior of the case, never being sufficiently great to cause discomfort nor to give rise to symptoms of cerebral pressure. On the whole, it may be said that operative attempts at repair should not be made until three months after the original operation unless the behavior of the case be manifestly so favorable as to warrant earlier interference. Nature, time, and patience will do much in this class of cases. Undue haste may do harm.

At times a cerebral prolapse becomes dermatized, the protrusion being still considerably elevated above the skull level. This, of course, obtains when the bone has been sacrificed. The protrusion is then called a hernia cerebri, in contradistinction to prolapse, which latter term should be applied to protrusions of brain not covered by any tissue.

Fig. 237 shows a case of moderate hernia cerebri following

Fig. 237.—Cerebral Hernia Following Resection of the Skull. (*Krause.*)

osteoplastic resection of the skull for enucleation of a cerebral tubercular form. This is a fair sample of the ultimate outcome in this class of cases, though in a certain number of cases no deformation of the cranial outline persists. If the patient feels any discomfort or apprehension at the presence of the hernia, it may be protected by the wearing of a truss, though this will only rarely be found necessary.

THE RETAINING BANDAGE

Following operations on the scalp, cranium, and contents, the retaining bandage is applied in the form of a cap made up of properly adjusted roller bandages. Covering of the entire skull with the dressing is cumbersome, and when the operation has been limited to removal of growths of the scalp, the dressing for the first twelve hours following may consist of a liberal amount of gauze held in place with the roller bandage. However, the oozing of secretions will have ceased by this time, and the wound may now be sealed with a mixture of iodoform and collodion, a half dram

FIG. 238.—SINGLE ROLLER BANDAGE OF THE HEAD. Beginning in the median line the surgeon lays each succeeding turn of the bandage a little further to the right or left. (*Foote.*)

to the ounce, or aristol may be substituted for the iodoform if the odor of the latter is offensive.

The ether holding the guncotton in solution evaporates and leaves the latter, holding the antiseptic confined in its meshes, in contact with the wound. The application holds the stitches firmly enmeshed, and may be left in this way for six days without interference. Remembering that the guncotton is soluble in ether, it is only necessary to apply the latter to the surface, and the mixture of collodion, antiseptic powder, and a small amount of bloody secretion is readily removed, permitting of withdrawal of the sutures without causing pain to the patient. When the stitches have been removed, the wound may be again coated with the collodion-iodoform or collodion-aristol mixture, and the ultimate repair will take place beneath this protection without further attention.

When the operation is of greater magnitude, the dressing is held in place with roller bandages which cover the entire skull. A two-inch bandage is used for the purpose. The single roller may be employed and is applied in the manner shown in Figs. 238

FIG. 239.—SINGLE ROLLER BANDAGE OF THE HEAD COMPLETED. (*Foote.*)

and 239. The double roller is best used where it is desirable to make pressure on the wound, especially in making compression following invasion of the bone. The mode of application of the latter form of bandage is shown in Figs. 240 and 241. Frequently patients who have been subjected to operations on the cranium and its contents are, as already stated, exceedingly restless. The continuous tossing about is likely to loosen the bandage, with undesirable results. In these instances it is well to supplement the

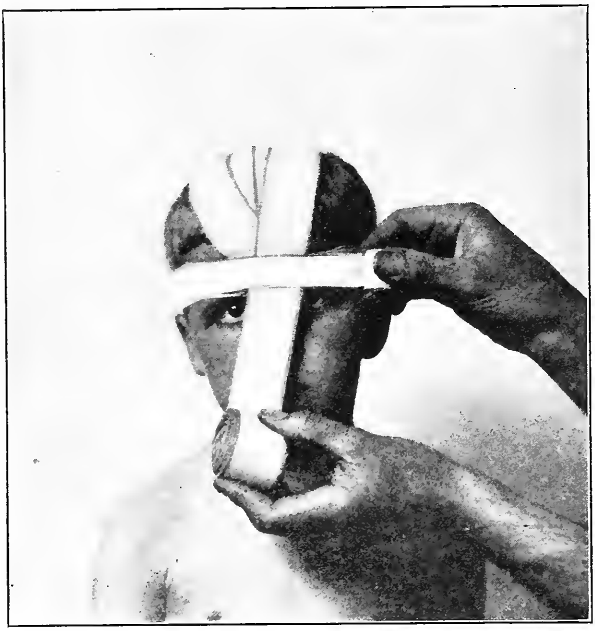


FIG. 240.—DOUBLE ROLLER BANDAGE OF THE HEAD. Each circular turn of the narrower bandage fixes the reverse of the wider one on the forehead and on the occiput. (*Foote.*)

cap dressing with an "anchor bandage" applied in the way shown in Fig. 242, which may be applied over the retaining single or double roller bandage.

Patients suffering from cerebral irritation frequently pick at the dressings. It is not always wise to administer opiates in these cases, at least not in sufficient quantity to produce unconsciousness, on the ground that the symptomatology of the postoperative period is masked by so doing. It is not uncommon to see patients insinuate the fingers beneath the edges of the roller bandage and gradually loosen the strips, ultimately tearing aside the entire dressing. In these instances a cap made of unbleached muslin

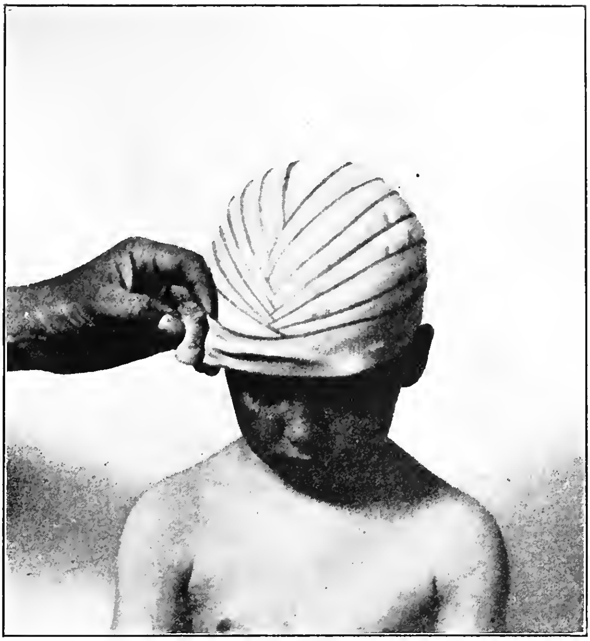


Fig. 241.—Double Roller Head Bandage Completed. (*Foote.*)

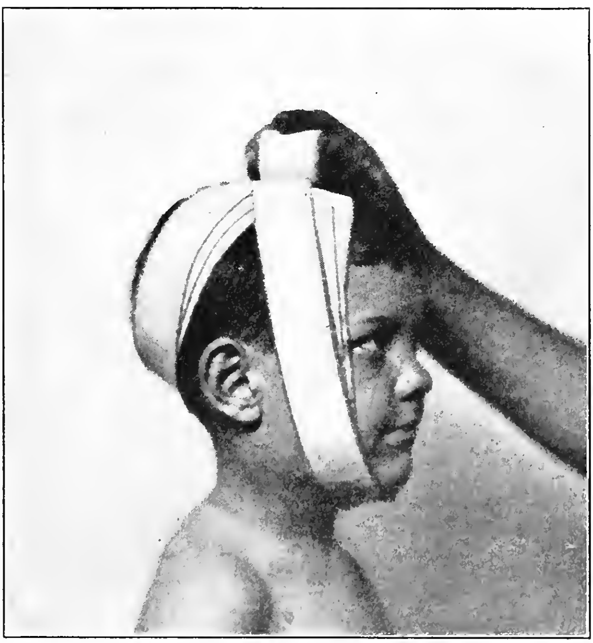


Fig. 242.—Figure of Eight Bandage of the Head, Showing Anchoring. (*Foote.*)

may be applied to the head and fastened firmly beneath the occiput with tape (Fig. 243). The smooth surface of the cap makes it

FIG. 243.—SKULL CAP FOR DELIRIOUS PATIENTS FOLLOWING OPERATIONS ON THE HEAD.

difficult for the patient to grasp the dressing and prevents loosening when the head is tossed about upon the pillow.

MASTOID OPERATIONS

THE SIMPLE OPERATION

The preparation of patients to be subjected to operations upon the mastoid cells and contiguous tissues does not materially differ from that in operations in other situations. It is to be remembered that the invasion of the mastoid cells is usually undertaken for the relief of suppurative inflammations, which suggests that the technic of the operative procedure should aim at antisepsis rather than asepsis. The care of the wound is very similar to that which obtains in infected wounds in other portions of the body. The wound at the end of the operation is lightly packed with iodoform gauze. The packing should be made in such a way as to avoid undue pressure upon the tissues. Firm pressure for twenty-four hours may be necessary if there be much oozing of blood at the close of the operative procedure. If the tamponade be firmly introduced for this reason, it should be removed carefully at the end of twenty-four hours and a new tamponade of the same material introduced.

In this situation, as in all others, the object of the tamponade is to furnish a substance which will readily absorb the exudate and prevent the accumulation of offensive substances in the wound. Firm tamponade prevents the growth of granulations, interferes with the nutrition of the part, and it is no exaggeration to state that the patient would, no doubt, be better off if the wound were not packed at all. If the operation be the so-called simple mastoid operation the tamponade need not be disturbed for five or six days. The indications for earlier change of the tamponade are excessive soiling of the dressing with secretion, pain, fever, or an offensive odor (*Kopetzky*). If the outer dressing be saturated with secretion, this may be changed and the dressing immediately contiguous to the wound be left undisturbed, unless one or more of the indications mentioned be present.

When the dressing is ultimately changed the iodoform gauze is loosened with peroxid of hydrogen and carefully removed with the view of obviating undue trauma to the newly formed granulation tissue.

The general surgical principle of keeping a wound free from foreign substances should be conserved here, too. The gauze tamponade should become progressively less bulky, and when the granulations reach the skin surface be omitted entirely. Disregard of this rule will cause the existence of an offensive condition of affairs lasting over a long period of time and, in the opinion of the writer, is frequently responsible for the unfavorable cosmetic effect which so often follows mastoid operations. It is suggested that the ear specialist apply general surgical rules to the class of cases with which he comes in contact.

The after-treatment of cases treated without tamponade. After the wound is thoroughly cleansed, the cavity is insufflated with boric acid powder. *Kopetzky* uses aristol for the purpose, but places a small gauze drain into the meatal orifice. He reports good results from the measure. The advantage of this procedure is that the changes of dressing are quite devoid of pain, also that granulation is not retarded.

In cases where epidermization is tardy and no local impediment to its advancement is to be found, *Bondy* obtains good results from the local application of concentrated etherial solution of picric acid (1.0-10.0). The mixture is applied after the parts are thoroughly cleansed. Its disadvantage lies in the intense pain caused by the application. This, however, ceases as soon as the ether has evaporated. To hasten evaporation, air is blown into the wound. This treatment is administered every second day, and during the intervals the wound is kept dry by insufflations of boracic acid or dermatol.

When this plan is adopted the wound secretions rapidly lessen in amount, and exuberant granulations disappear, while the wound surface rapidly becomes covered by epithelium.

In a certain number of cases, after thoroughly cleansing the wound cavity, we have been very successful in checking exuberant granulations by applying orthochlorphenol, followed by absolute alcohol; but in the majority of our cases we simply change the soiled for a clean dressing, and kept the wound surface dry. This has yielded good results. Very often, after epidermatization has taken place on one section of the wound cavity, destruction of the newly formed epidermis takes place, due to the action of the wound secretions from other parts of the cavity. To prevent this, the recommendation of *Brühl*, namely, to cover the newly formed epithelium with zinc ointment, deserves mention. We have used lanolin with excellent effect for similar purposes.

Dermatitis of the meatal orifice or surrounding tissue, often results from faulty asepsis, but occasionally this condition is due to the action of the secretions. Regarding dermatitis, the deleterious effects of iodin should be remembered. We dispense with iodoform after the first dressing, substituting either plain gauze or boracic acid, or aristol insufflations. In children, we entirely dispense with the use of iodoform gauze.

Our own procedure in the local after-treatment of these operations is extremely simple. We check any tendency to exuberant granulations by any of the above-named measures; we change the dressings every second day, and unless the secretions are excessive, we wipe the cavity clean with dry or moist wipes—moistened in normal salt solution. The tamponade after the second week is very light; usually in cases progressing satisfactorily we content ourselves with placing a strip of plain gauze in the meatal orifice, and extending it to the antral opening. Previous to the introduction of this tampon, aristol is insufflated.

When the secretions are excessive, we instill hydrogen peroxid, and follow this with 95 per cent. alcohol. This usually gives satisfactory results. Where granulations are indolent, general systematic treatment, an outdoor life, and nutritious diet are indicated, together with the local application of Peru and castor oil in equal parts. One or two applications of the latter are usually sufficient to stimulate indolent granulations. (*Kopetzky.*)

THE RADICAL OPERATION

When the radical operation has been performed the introduction of gauze is limited to a single gauze strip, which is intended for drainage. The introduction of firm packing interferes with the intent. The dressing is left undisturbed for a week. Indeed, the wound is treated in all respects similar to that applied to aseptic cases, except that the drain is employed. The stitches are removed at the first dressing. The dressing is, of course, removed if during the healing process there are any manifestations of accidental infection, in which event the wound is treated as are infected wounds in other situations.

RESULTS OF AFTER-TREATMENT

The length of time required for healing is different in every case. It is manifestly unfair to compare the results obtained from a procedure which in itself is the same, but which is employed to cure different diseases in the temporal bone. In general, the best results are obtained in from six to eight weeks. Many cases are under treatment for months, and some for years, before final recovery can be pronounced. This is especially the case in under-nourished children and in adults debilitated from general disease, and it is an especial feature of tuberculous mastoiditis. The average duration of the after-treatment is between three and four months. (*Kopetzky.*)

INTRACRANIAL NEURECTOMY

Intracranial neurectomy, *i.e.,* removal of the ganglion of *Gasser* involves much the same problem as regards preparation of the field of operation and the local after-treatment as obtains with the problem of section of the skull for other purposes. These considerations have been so largely entered into under operations on the brain as not to need repetition here. However, it is perhaps proper to state in this connection that the bone is quite frequently sacrificed in approaching the ganglion, though the osteoplastic resection is also made in a not inconsiderable number of cases. The former technic is less likely to be followed by superficial necrosis of bone than the latter. However, some necrosis of the bone does occur in either instance. The evidences of its presence and the care given the wound until exfoliation takes place are already described, being in all regards similar to those following opening of the cranium for other purposes.

Of course the operation is not undertaken for infection, and if tamponade is made, it is with the intent of controlling bleeding. This argues for removal of the tampon at the end of forty-eight hours sequential to the operation. A small drain of silk-worm gut should, however, be introduced into the wound at this sitting, with the view of furnishing an avenue of egress for the secretions attendant upon wound repair, and possibly to allow of discharge of disintegrated bone tissue. The fact that patients who are subjected to intracranial neurectomy have suffered violent pain for extended periods of time, permits of the assumption that anodynes have been more or less employed to afford relief. Probably a considerable number of persons afflicted with trifacial neuralgia are more or less habitues in this regard. This must be taken into consideration immediately after the operation and no radical effort made to correct the habit immediately after the ganglion has been removed. This question has been taken up under a general head (page 30).

In the after-treatment, the care of the eye on the side where the ganglion has been removed calls for special precautions. The injury to the sympathetic nerve fibers while the ganglion is being resected disturbs the nutrition of the eyeball, and the loss of sensation results in the accumulation of foreign particles upon the eye which otherwise would be dislodged by winking. This is obviated by suturing the eyelids over the eyeball for four or five days following the operation.

During this time the eyeball should be washed off by syringing a saturated solution of boracic acid beneath the eyelids at frequent intervals. This should be done every four or five hours and the solution should be warm. Later than this a shield should be worn over the eye, and cleanliness observed for a long period of time. It would appear that, until the nutritive changes are balanced by nature, care in maintaining nutrition of the body has a tendency to prevent the sloughing of the cornea, due to alteration in this respect, the outcome of injury to vasomotor nerves.

Patients who have been subjected to intracranial neurectomy should be fed as largely as is consistent with the other indications manifest after operations of magnitude. More especially is this true in view of the fact that, as a rule, considerable modification of general nutrition will, in all probability, have already taken place, the outcome of the protracted suffering from the neuralgia.

CHAPTER XVII

OPERATIONS ON THE FACE

Rhinoplasty—Osteoplastic rhinoplasty—Harelip and cleft palate—Miscellaneous operations in mouth.

The sources of infection in operations on the face, other than those which obtain from causes necessitating the operation, are the hair and the nasal and the oral secretions. The hair of the scalp should be treated in much the same manner as for the removal of benign growths from the scalp. The scalp is anointed, the day before the operation, with olive oil or vaseline and shampooed very thoroughly with tincture of green soap for a few hours before the operation. The hair is then wrapped in a sterile towel. If the operation contemplates attack of the parts contiguous to the hairy scalp, the towel may be moistened with a solution of corrosive sublimate 1 in 2,000. The method of application of

Fig. 244. Applying Aseptic Cap. First Step. (*Gerster.*)

the towel is shown in Figs 244 and 245. Fig. 246 shows the towel retained in place with a sterile gauze bandage.

In men the face should be shaved a few hours before the operation. It is best to have a barber do this, as the nicking of the skin consequent upon unskilled manipulations of the razor is conducive to infection and causes unnecessary annoyance to the patient. Operations upon the forehead, eyes, and cheeks above the level of the nostrils do not call for special precautions in after-treatment. The mode of applying the retaining dressing in this class of cases is shown in Fig. 247.

Fig. 245.—Applying Aseptic Cap. Second Step. (*Gerster.*)

Following operations involving the forehead and the eyelids, and, indeed, a small area of the cheek, the bandage is applied as shown in Fig. 248. This form of bandage is used in instances in which there is not much trauma at the time of the operation, such as removal of a superficial sebaceous cyst or a small dermoid cyst from the region of the eyebrow.

Fig. 246.—Aseptic Cap, Held in Place with Sterile Gauze Bandage. (*Gerster.*)

The operations need not be followed by the elaborate dressing shown in Fig. 247. Each alternate turn is crossed in the manner shown in the illustration, and a pin is ultimately made to penetrate all the layers of bandage at the site of crossing. The ban-

FIG. 247.—DRESSING FOR WOUNDS OF FACE ABOVE NOSTRILS. (*Gerster.*)

dage should be made of one and a half inch material. Gauze is used for the purpose because it is more pliable than linen and will conform more readily to the irregular outline of the parts.

Wounds of the face heal rapidly, the outcome of the vascularity of the part, and, perhaps, also because of the presence in large quantity of glandular elements in this situation, resembling, in these regards, the scalp. The suture material best employed in this portion of the body is horsehair or fine

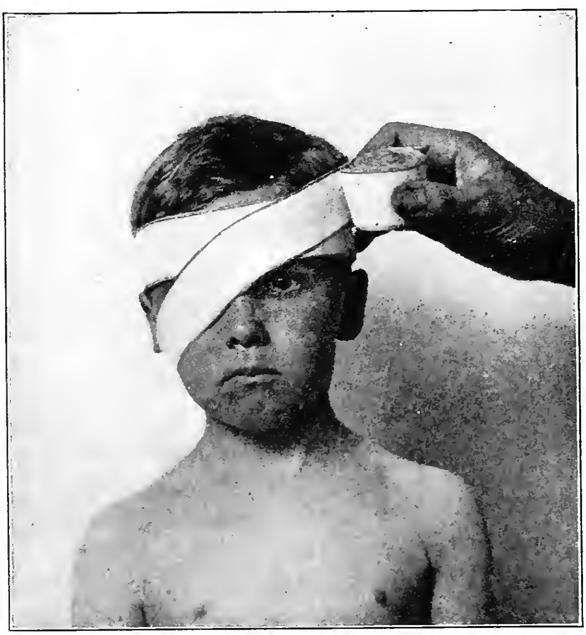


FIG. 248.—BANDAGING UPPER PORTION OF ONE SIDE OF FACE. (*Foote.*)

silk-worm gut. The subcuticular suture is followed more frequently by suppuration than the usual interrupted suture. This is perhaps due to the trauma to a large number of glandular elements of the skin, which are the habitat of bacteria as far as their ducts are concerned, and the needle, passing through them laterally, liberates the bacteria, permitting of invasion of the surrounding tissue.

A fine silk-worm gut threaded upon a slender *Hagedorn* needle, introduced in the interrupted method and tied just sufficiently tight to hold the tissues in apposition without strangulation, will produce desirable results. The sutures should not be permitted to remain *in situ* longer than six days, when they should be carefully removed, using slender scissors for the purpose and avoiding unnecessary trauma to the surrounding skin surfaces. The needle holes will then disappear very rapidly. The wound may then be sealed with collodion iodoform or collodion aristol, and the ultimate repair takes place under this seal.

For some unknown reason, erysipelas is more frequently a complication of wounds of the face than obtains in other situations of the body. This occurrence need not be regarded as portentious of unfavorable cosmetic outcome. Recovery from the erysipelas is usually followed by a complete restitution to the normal, and the fact that it has occurred need not be considered a reason for permitting the sutures to remain *in situ* any longer.

When facial erysipelas occurs as a postoperative complication, the sutures may be removed in the usual way, and the infected surface, together with the wound, covered with a 25 per cent. solution of ichthyol in collodion, and the constitutional treatment is carried out as usual.

Asepsis has made this occurrence quite rare, yet it does occur, and a meddlesome policy, the result of apprehension with respect to the wound, is to be deprecated. The writer has seen quite satisfactory ultimate cosmetic results follow the method of procedure here indicated. Of course, if suppuration occurs either from pyogenic infection or is due to the streptococcus of *Fehleisen* together with a pus organism, the wound is treated by opening of a portion of the wound, drainage, and light packing as indicated above (page 305).

A sharp rise of temperature with moderate acceleration of pulse rate and little or no pain usually means facial erysipelas. A moderate rise of temperature, sharp increase in pulse rate, with pain and throbbing, would indicate pus infection. The former permits of conservatism and abstinence from interference with respect to the effort at immediate union, the latter calls for liberation of secretions, loosening of sutures, and drainage.

Operations on the face involving areas which are liable to be contaminated with nasal or oral secretions call for special precautions, both with respect to preparation and after-treatment. It is quite impossible to render sterile the secretions from mucous membranes. However, the number of pyogenic organisms present may be reduced to a minimum, and the tissues may be relied upon to resist their invasion if present in small number.

For several days before the operation the mouth and nasal cavities are frequently lavaged with listerine or a similar preparation. In the mouth listerine may be used undiluted as a wash, and this followed by gargling with large quantities of the agent diluted to one-third of listerine and two-thirds of sterile water. This acts most largely mechanically, though some chemical effect is produced by the agent. It is necessary to use large quantities of the fluid with the view of diluting and perhaps exhausting the virulence of bacteria. The teeth should be thoroughly cleansed, preferably by a dentist, several days before the contemplated operation, and the brush used frequently until that time. Corrosive sublimate and carbolic acid solutions are not safe agents to use in this situation.

The nose is douched with the same solution, though pure listerine used in this way is advised against as being too irritating. Care should be taken in lavaging the nasal cavities to permit of easy egress of the cleansing solution. If this precaution be not taken, the middle ear may be invaded by way of the *Eustachian* tube, and unpleasant complications in this situation may develop as the result. A convenient and comparatively safe method of lavage of the nasal cavities is to introduce from the mouth, behind the soft palate, a suitably curved nozzle fitted to the barrel of a syringe (Fig. 249), which washes the nasal cavities from behind, and the cleansing fluid flows unobstructedly from the anterior nares.

If the secretion in the nose is crusted, a saturated solution of sodium bicarbonate, warmed to the body temperature and introduced as described, will be found quite effective in removing the incrustations. The comparatively clean mucosa may now be freely lavaged with additional cleansing fluid, such as boric acid, listerine 1 in 3, or the like, using the same syringe for the purpose.

Immediately before the operation, the mucosa of the nose may be painted with a solution of adrenalin 1 in 3,000, which arrests the secretion for a time, and, indeed, for the twenty-four hours following the operation the mucosa may be kept contracted in this way, effectually limiting the mucous secretions.

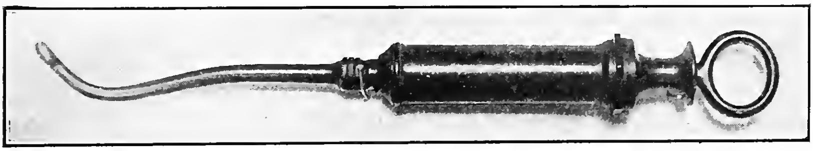


FIG. 249.—SYRINGE FOR CLEANSING NASO-PHARYNX.

This measure is not so effective in the mouth, as the salivary secretions come from glands remote from the local influence of the adrenalin. However, the salivary secretion may be lessened by the administration of a small dose of atropin (1-120 gr.), and the secretion from the mucosa itself controlled with the adrenalin solution. Attention to what appears like minor considerations of this sort may determine the question of postoperative infection.

The salivary secretion is probably sterile as it emerges from the ducts of the salivary glands, and is later contaminated as it mingles with the mucous from the lining membrane of the mouth. If the mucosa be kept clean, the saliva need not be regarded as of menacing import in this connection. It is also probable that but little saliva from the salivary glands themselves is secreted at other times than during mastication. A diet which does not call for the exercise of this function is a logical indulgence.

The sterilization of articles of diet is taken up under separate head (page 430). In this connection it is proper to state that whatever efficiency, as regards nutritive value, food loses as the outcome of sterilization need not be considered as an important factor when used for a short period of time. The introduction of food through the mouth by means of sterile apparatus of prehension should, of course, be assiduously practiced in all cases where the organs concerned in deglutition are subjected to operative attack (page 430).

The dressing of operative wounds contiguous to the nose and mouth is held in place with some difficulty. For the purpose it is necessary to apply an elaborate protection, which, though cumbersome, and likely to provoke some rebellion on the part of the patient, should, nevertheless, be applied.

A combination of head cap, jaw bandage, and neck dressing, covered with rubber tissue, elastic rubber sheeting, or oiled silk to obviate saturation from without with articles of diet and secretions, as shown in Fig. 250, may be employed. The illustration shows, also, the arm sling and axillary dressing. The latter, of course, are not added unless the neck has been subjected to operation at the same time, and may be omitted in face cases.

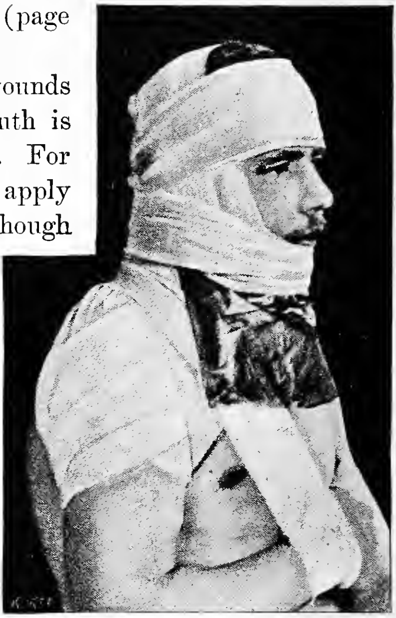


Fig. 250.—Dressing for Face and Neck Operation. The arm sling is omitted if neck is not invaded. (*Gerster.*)

RHINOPLASTY

Rhinoplasty should be preceded by cleansing of the nasal cavities described above. The after-treatment relates to prevention of tension and avoidance of infection during healing. Patients operated upon for correction of deformity in this situation will be found exceedingly tractable and easily managed, provided, of course, the operation be undertaken when the patient is sufficiently advanced in life to contribute to the effort of the surgeon with intelligent coöperation. If the operation be made under local anesthesia, the posture of the patient immediately subsequent to the operation is easily indicated and maintained. When, however, narcosis has been employed, the patient must of necessity be placed in the dorsal decubitus for several hours until consciousness returns.

Most persons who have been subjected to narcosis vomit. The vomitus oozes through the nose and is likely to contaminate the field of operation. Cases of this sort should be watched by an efficient assistant, who, by careful attention to detail, removes the vomitus from the region of the wound. When the vomiting has ceased, the wound should be redressed, the nasal and oral cavities thoroughly cleansed, and a fresh protective dressing applied.

In a considerable number of cases drainage tubes are placed into the nostrils with a view of promptly removing contaminating discharges from the area of operation. These are liable to be displaced during vomiting, and should be replaced with sterile tubes when this contingency arises.

After operations on the nose the sitting posture should be maintained as soon as feasible for the purpose of facilitating drainage. The quantity of nasal secretions is increased by the presence of drainage material. If it be regarded necessary to employ drainage tubes, an attendant should very frequently cleanse the surface contiguous to the point of egress of these agents.

During the waking hours the patient may be furnished with a hand mirror and a basin of corrosive sublimate solution (1-3,000). Small gauze sponges are placed in the corrosive sublimate, which the patient removes at frequent intervals and wipes away the secretion. During the sleeping hours an attendant should be available for this purpose.

The tubes are removed every twelve hours and replaced with sterile ones. Tube drainage should not be maintained for longer than three days for fear of pressure necrosis. Packing of the nostrils for a protracted period of time should be avoided. Infection of the accessory sinuses and cavities may be the outcome of firm packing permitted to remain *in situ*. Empyema of the antrum of *Highmore*, and infection of the ethmoid and sphenoid sinus may result if these precautions are disregarded.

In addition to this, the nasal cavities are gently lavaged from behind with the syringe shown in Fig. 249, using a mildly antiseptic solution for the purpose (potassium permanganate 1 in 1,000). Tension upon the sutures is relieved by immobilizing the contiguous soft parts with adhesive plaster strips. These should be gently removed daily and replaced with new ones. For this purpose it is well to remember that rubber is soluble in ether, and the plaster strips may be removed by the application of this agent, thus avoiding unnecessary trauma to the wound and annoyance to the patient, which accompany the forcible removal of the plaster.

The surroundings of these patients should be quiet with the view of avoiding the muscular effort attendant upon conversation and laughter.

The postoperative diet need not be sterile in this class of cases. However, as mastication calls for the use of muscles which are attached to the field of operation, the diet should consist of liquids taken through a tube or by means of the feeding cup for several days after the operation.

The patient should be encouraged to sleep in the sitting posture, a position easily maintained by means of the bed-rest.

It will be found advantageous to give attention to detail, the neglect of which may determine the outcome.

OSTEOPLASTIC RHINOPLASTY

Osteoplastic rhinoplasty, such as the *Koenig* method, demands patience in after-treatment. The bone flap may not unite primarily, and, indeed, a portion of it may necrose. This does not mean that a favorable outcome need be despaired of. A portion of the flap, if it retain its vitality and become fixed in place, will result frequently in a good cosmetic result, though at the time of the healing process it looks anything but indicative of this outcome.

In these cases the wound must be kept clean and the disintegrated bone tissue gently removed. Forcible manipulation of the parts at this time interferes with nutrition and should be avoided. The use of strong antiseptic solution in this connection is unwise. A mild solution of potassium permanganate (1 in 1,000) may be used. Exuberant granulations should be treated with the nitrate of silver stick. Care should be exercised in applying the silver to avoid trauma to the white epithelial edge of the wound. When a sinus persists, the pouting excrescent granulation which frequently extrudes from the opening should be cut away with fine scissors curved on the flat, and the bleeding surface lightly touched with the caustic stick. The application of tincture of iodin into the sinus by means of a small cotton pledget wound about the end of a slender probe will stimulate granulations and destroy pyogenic organisms. The application may be repeated every three or four days for several sittings.

Hydrogen peroxid should not be introduced into the nasal cavities; the effervescence may force infective material into the accessory sinuses and the antrum. The essential factors in the after-treatment of wounds in this situation are frequent cleansing of the field with large quantities of mildly antiseptic solutions, drainage, avoidance of meddlesome manipulations, and immobilization of the apposed wound surfaces.

Resection of one or both superior maxillæ, invasion of the antrum of *Highmore,* and accessory sinuses, such as the ethmoid, sphenoid and frontal sinuses, demand practically the same after-treatment described with rhinoplasty. The fact that attack upon these parts involves invasion of the mouth, demands that this cavity be given the same preparation described under the general preparation for operations on the face. The administration of sterile diet is essential in these cases. The reader is referred to the discussion of this problem on page 430, *et seq.*

HARELIP AND CLEFT PALATE

Harelip and cleft palate cases are prepared for operation in the same way as the cases discussed above. However, the precautions with respect to subsequent cleanliness and the avoidance of unnecessary disturbance to the field contiguous to the wound is especially emphasized at this time. The impracticability of applying a protective dressing which is efficient in these cases renders them difficult to manage.

In harelip cases *Gerster* advises against the application of a cumbersome dressing and simply dusts the wound with iodoform powder. This forms a paste when mixed with blood and secretions, which, upon drying, makes an efficient protection to the wound. *Gerster* also deprecates the employment of strips of adhesive plaster intended to overcome tension. He regards their presence, in infants, as irritating, causing the little patient to cry and tear asunder the sutures.

In adults this does, of course, not obtain, and a small square of iodoform gauze may be placed in contact with the skin wound and held in place with plaster strips. The dressing must be changed twice daily for the first three days. Thereafter a daily change of dressing will suffice. Harelip pins should not be permitted to remain *in situ* longer than seven days. At this time union in the wound will have taken place, and the ulceration consequent upon the presence of the pins will not have progressed sufficiently to interfere with favorable ultimate cosmetic outcome. The apposition sutures may be removed at the same time. If catgut has been employed for the latter purpose it will have undergone absorption by this time. However, when it is borne in mind how much less trauma attends upon the employment of very fine silk-worm gut or horsehair, the use of catgut in this class of cases may be regarded as objectionable.

In cleft palate it is, of course, impossible to apply the protective dressing. Especial care should, for this reason, be given to the preparation of the mouth. The care of the teeth and the thorough cleansing of the mouth with a solution of potassium permanganate (1 in 1,000), frequently applied, should be indulged in for several days before the operation. Hydrogen peroxid may be used for the purpose, as the effervescence in the mouth is not objectionable.

Articles of diet should be introduced by means of a sterile tube. The food, which should be in liquid form, is sucked up through the tube. However, in cases of harelip this effort makes demand upon the muscles of the lips, and this is objectionable. In infants it is wise to administer food through a catheter passed through the nose, for two days following the operation.

Adults can be instructed to achieve the object without using the lips. It will be found quite feasible to introduce the food into the pharynx by manipulating the tongue against the palate and holding the lips still. A sterile feeding cup answers the purpose very well. The liquid is allowed to run into the mouth and is readily swallowed without any effort upon part of the lips. In this class of cases it is quite justifiable to administer atropin with the view of lessening salivary secretion. The digestive function of the saliva may well be dispensed with for the postoperative period, and the diet may be restricted to articles which do not contain large quantities of carbohydrates. The small quantity of sugar contained in milk will be taken care of by the digestive secretions in the intestinal canal, without the unimportant aid given by the saliva.

After operations for *cleft palate* the sutures may remain in place until the tenth day if no contraindication present. The question of cosmetic effect, with respect to the stitch holes, does not come into consideration in this situation. Especially is it wise to keep the sutures in place for ten days or two weeks if the operation has comprehended invasion of the bone.

For the purpose of holding the bone in place, silver wire is frequently used. This may be permitted to remain *in situ* for several weeks without untoward manifestations arising, provided a reasonable degree of attention be shown cleanliness.

Attention to detail, painstaking observation of the aseptic and antiseptic methods of care of wounds, and sterilization of articles of diet, are necessary to success in this class of cases.

MISCELLANEOUS OPERATIONS IN MOUTH

Removal of a part of or the entire tongue, resection of the oral mucosa, excision of the inferior maxilla, and, indeed, other operations of greater or lesser magnitude which involve communication of the wound surface with the mouth, call for the exercise of the directions just offered. Intrabuccal removal of the tongue for malignant disease is rarely limited to this step. The general rule, that contiguous lymph glands should be removed at the same time, frequently permits of the maintenance of dependent drainage through the wound in the neck. This renders keeping the mouth wound clean a comparatively easy matter. Drainage in this way should be maintained until the mouth wound is quite healed.

Resection of the tissues in the mouth for gumma, tuberculosis, and benign neoplasms, such as racemose angiomata, do not comprehend opening of the neck in all instances. In these cases the mouth is kept clean with some difficulty. However, persistent cleansing, together with the precautions mentioned, will obviate infection in the majority of instances.

Fig. 251.—Janet-Frank Syringe Armed with Soft Rubber Tube for Cleansing Mouth after Operation.

It is true that the maceration of soft parts consequent upon the liberal use of solutions interferes with healing, and that wounds which are kept dry will unite primarily in a short time. However, the situation of the wound and the contingencies to which it is exposed modify the technic of postoperative care in this situation.

For the purpose of cleansing the mouth, the introduction of the disinfecting solution is best accomplished with the *Janet-Frank* syringe, armed with a soft rubber tube slipped over the metal terminal of the instrument to avoid trauma to the tissues. (Fig. 251.) If lavage be made by means of a glass which the patient rests against the lips, the contact of the fluid with the skin before it gains access to the wound should be avoided. This is, of course, a minor factor, yet if it be true, as frequently stated in this work, that infection is a question of dosage, each avoidable dilution of the germicidal quality of a cleansing solution should be avoided. When cleansing the mouth the patient is placed in the sitting posture, with the head bent forward and the mouth held wide open. An assistant, or the patient, holds a goodly-sized basin beneath the chin, and the surgeon, who is seated on a low stool beside the patient, injects the cleansing solution from below (Fig. 252). The solution is thus permitted to flow over the wound surface and is readily discharged, thus avoiding forcing of secretions back into the pharynx. The necessary amount of pressure is easily regulated.

A fountain syringe hung two feet above the level of the patient's mouth will answer the purpose very well. In this event, a number of glass nozzles are kept constantly submerged in a jar filled with carbolic acid solution, and a new nozzle is used at each

FIG. 252.—CLEANSING PATIENT'S MOUTH AFTER OPERATION.

sitting. The advantage possessed by the syringe is that the solution is less apt to become contaminated, as the hands come in contact only with portions of the instrument not closely applied to the wound. Between times the syringe is kept immersed in an antiseptic solution.

Shreds of necrosed tissue are carefully removed with thumb forceps. If a necrosed shred should be somewhat firmly attached its separation may at times be achieved by a slightly more forcible projection of hydrogen peroxid against the point of attachment.

After thorough cleansing, the wound surface may be lightly dusted with iodoform powder. The offensive odor of this agent is very disagreeable to patients. However, it is fair to say that nothing will take its place, and its disagreeable qualities had best be borne.

Iodoform poisoning is quite likely to occur when the agent is used in the mouth, for obvious reasons. Bismuth cakes and is not very effective. The use of corrosive sublimate solutions should be avoided.

CHAPTER XVIII

OPERATIONS ON THE NECK

Torticollis—Tuberculosis of cervical lymph glands—Operatians on larynx and trachea: intubation of larynx; tracheotomy; laryngectomy; thyroidectomy; exothyreopexy; drainage and packing of cysts of the thyroid; esophagotomy.

The preparation of the surface of the neck for operative attack does not differ in any essential regard from that which obtains in other situations. The preliminary care of the upper air passages preceding attack upon the larynx and trachea is quite similar to that employed in preparing cases for operations involving the nose and mouth (page 362). The same conditions obtain with respect to operations upon the esophagus. The question of diet is taken up under discussion of gastrointestinal surgery.

Fig. 253.—Left Torticollis Showing Method of Fixing Head in the Over-corrected Position after Operation. (*Whitman.*)

TORTICOLLIS

The subcutaneous division of the sternomastoid has been quite abandoned since the advent of asepsis. After suture of the muscle by the open method, the wound of approach is closed with silk-worm gut sutures and the neck immobilized in the over-corrected position (Fig. 253), using a stiff bandage of starch or plaster-of-Paris for the purpose.

The immobilization is maintained for fourteen days, when the dressing is removed and the stitches, if they be of nonabsorbable material, removed. If the catgut has been used the sutures will have been absorbed by this time.

FIG. 254.—MANIPULATION OF NECK AND MASSAGE OF MUSCLES AFTER OPERATION FOR TORTICOLLIS. (*von Bergmann.*)

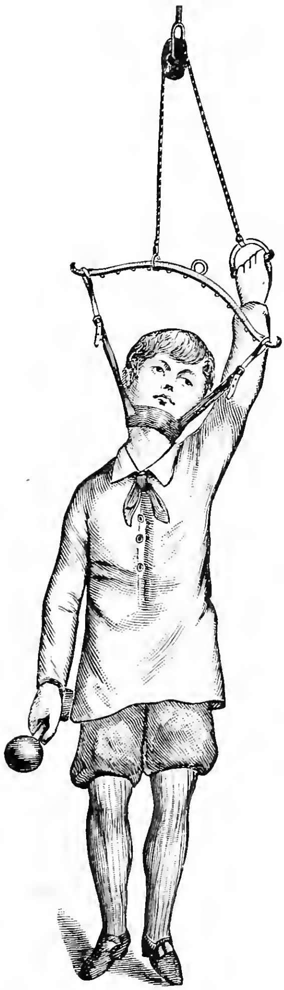


FIG. 255.—*Glisson's* SLING FOR APPLYING COUNTER EXTENSION TO THE SHOULDER AFTER OPERATION FOR TORTICOLLIS. (*von Bergmann.*)

The after-treatment consists of massage and passive motion destined to overcome the malposition of the cervical vertebræ. If this be not assiduously carried out, the deformity is liable to recur, or, at least, complete correction will not be attained. The method of massaging the neck muscles and correction of the deformity is shown in Fig. 254. The symmetrical development of the muscles of the neck and shoulder is conserved by the use of a *Glisson* sling and counterweight held in the hand. The opposite hand grasps the handle of the pulley rope, and the patient raises himself upward by his own muscular efforts (Fig. 255).

These manipulations must be carried on for a long period of time (months). In addition, the patient should be encouraged to indulge in exercises designed to correct the deformity, such as systematic class exercises in a gymnasium or training in a military school, where his pride and a desire to do as well as his comrades will stimulate him to an erect carriage with the eyes directed ahead. Rowing, boxing, fencing, and wrestling should be discouraged until the deformity is quite overcome, on the ground that the muscles previously overdeveloped might be strengthened beyond the affected ones. The parent or friend can be easily taught the proper kind of manipulations to employ. Patients should not be permitted to carry out the after-treatment themselves. The stimulating effect of companionship and extrinsic interest will do much to obviate neglect of the orders given.

TUBERCULOSIS OF CERVICAL LYMPH GLANDS

The preparation of the field of operation for removal of tuberculous lymph glands varies somewhat, depending upon whether mixed infection, periadenitis, abscess and consequent sinuses exist. In the simple, uncomplicated cases no special precautionary preparation need be made, except that after the skin has been sectioned it would seem logical that antiseptic solutions be used for lavage of the deep wound. For the purpose, a solution of corrosive sublimate 1 in 2,000, liberally flowed over the field at frequent intervals, is a useful measure. The wound is smeared with iodoform powder and drainage established. The drainage material found serviceable in this connection is silk-worm gut (Fig. 147), or at times when there is a reasonable certainty that primary union will be attained the catgut drain (Fig. 149) may be inserted. The latter has the advantage that it need not be removed, and the dressing need not be changed for eight or ten days following the operation, at which time the sutures may also be removed. In cases complicated by sinuses and mixed infection, the operative field should be cleansed in the usual way and the skin anointed with a 20 per cent. oleate of mercury, twice daily, for several days before the operation. In other regards preparation of the operative field is the same as obtains in uncomplicated cases.

This method of preparation, together with excision of the sinuses, and especial care with regard to the exercise of antisepsis, have resulted in primary union in several instances at the hands of the writer.

Drainage is, of course, established in this latter class of cases, and the silk-worm gut or gauze drainage material employed. The wound is dressed at the end of forty-eight hours and cleansed with corrosive sublimate solution 1 in 2,000. The drain is removed at this time and a smaller one inserted. Drainage may be dispensed with at the end of another forty-eight hours if there be no indication to the contrary. Cleansing of the wound by the forcible injection of hydrogen peroxid is especially dangerous in this situation, as the deep fascial spaces communicate with the mediastinum and the two pleural cavities.

The effervescence consequent to the use of this agent may force fluids into these cavities. This applies also to the cleansing of superficial wounds of the neck. The forcible injection of cleansing fluids beneath the platysma may force its way beneath this muscle to below the clavicle and down upon the anterior aspect of the chest, where secondary infective foci have been known to develop as the result. This is to be borne in mind with respect to early drainage of suppurative inflammations in the neck, which, if permitted to proliferate to a considerable extent, will follow the paths indicated.

The constitutional after-treatment in these cases should be directed toward the resumption of nutrition as soon as feasible. As soon as postoperative vomiting and shock have been obviated, the feeding by mouth may be cautiously begun. The writer administers rectal feeding at the end of twelve hours if the vomiting persist. The liability to infection is lessened by maintaining the general tone. This is more essential in this class of cases than obtains in patients not afflicted with an exhausting disease.

When it is borne in mind that lung infection is a frequent, and bone infection a not rare, coexisting condition in these cases, the rationale of the proposition becomes apparent. The operation itself is exceedingly exhausting because of the more or less severe hemorrhage consequent to the attack of a region so largely supplied with blood-vessels. If to this be added a period of postoperative starvation, the liability to a sudden exacerbation of latent tuberculous processes in other situations in the body becomes a menace of considerable magnitude.

The patient should be set up in bed the day following the operation and the bed wheeled into the open air. The former conserves drainage, the latter stimulates the desire for food, aside from whatever therapeutic effect the inhalation of fresh air may have. As soon as the digestive functions are reëstablished, the generally accepted method of feeding in tuberculosis should be employed.

These cases for some reason frequently have tonsillitis following the operation. This is painful and interferes with the taking of nourishment. The writer finds it useful to permit the patient to take cracked ice at frequent intervals, and in addition gives sodium salicyl, gr. x, every two hours for six doses, with apparent benefit. As a routine measure creosote is given during the period of convalescence.

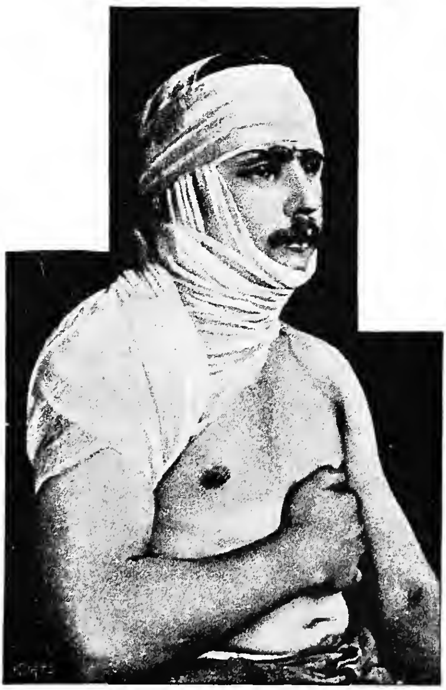


Fig. 256.—Dressing for Extensive Operation on the Neck. (*Gerster.*)

When extensive resection of the tissues of the neck up to the forman jugularis and down to the subclavian has been made, the dressing is applied in the manner shown in Fig. 256. Loss of sensation, the result of the division of sensory nerves, is a common sequel to this operation. Division of the auricularis magnus paralyzes sensation in the external ear. This, however, usually returns after several weeks, the function being taken up by filaments from the fifth cranial nerve. The loss of sensation in the skin of the neck is a small matter, and frequently is not noticed by the patient. Division of the spinal accessory causes limitation of motion in the sternomastoid muscle. This is at times distressing. Division of the cervicofacial paralyzes the angle of the mouth. This is only permanent in a small percentage of cases. These facts are mentioned in this connection with the view of obviating unnecessary concern to the patient. The removal of neoplasms from the neck does not call for special preparation nor after-treatment other than obtains in clean wounds in other situations. The general principles are to be applied here as previously discussed.

Immediately after the operation, and while the patient is still partially narcotized, care should be taken to protect the protective dressing from soiling with expectoration and vomitus. For this purpose the attendant covers the dressing with a towel firmly pinned about the neck and replaces it with a clean one as frequently as necessary. When the head is tossed about on the pillow the upper edge of the protective dressing is likely to be dislodged, leaving a space between it and the skin. Foreign material is quite liable to find its way under the dressing and come in contact with the wound, if this obtain, unless the precaution mentioned is observed.

OPERATIONS ON THE LARYNX AND TRACHEA

The preparation of patients about to be subjected to operative invasion of the air passages through the neck involves much the same preparatory steps, as described under operations on the mouth (page 362). If the epiglottis is not removed the administration of articles of diet subsequent to the operation need not be especially considered. In complete laryngectomy, including removal of the epiglottis, it is best to administer sterile food, on the ground that the tongue will not sufficiently protect the wound surface from the entrance of foreign substances.

INTUBATION OF THE LARYNX

The treatment following intubation of the larynx relates chiefly to the administration of food. When food gains access to the larynx, coughing is provoked and the tube is expelled. This is, perhaps, the greatest objection to employment of intubation.

O'Dwyer recommends placing the patient in the horizontal position with the head hanging over the edge of the table or attendant's knee, and feeding semisolid food with a spoon. The position is shown in Fig. 257. The passage of a soft catheter

FIG. 257.—METHOD OF FEEDING INFANT AFTER INTUBATION.

through the nose or by the mouth into the esophagus is useful, but the strangulation and gagging frequently dislodge the tube from the larynx when the latter methods are attempted. The fact that the laryngeal tube may be expelled at any time calls for immediate availability of a skilled attendant to reintroduce it.

If a string has been left attached to the tube, the patient's hands should be confined in such a way as to prevent its accidental withdrawal. The tube should be changed at the end of twenty-four to forty-eight hours. If dyspnea does not recur it need not be reintroduced. However, it will usually be necessary to maintain the intubation for three or four days.

The tube should not be left *in situ* any longer than is absolutely necessary, to obviate pressure necrosis. While the use of antitoxin for the relief of diphtheria has made less frequent the necessity for intubation, it is probably true that a case requiring intubation will give obstruction symptoms for three days, even though antitoxin be given. This is to be borne in mind in arriving at a conclusion as to when the tube may be permanently removed.

TRACHEOTOMY

The care of the patient subjected to tracheotomy is the same whether the operation involves the high, low, or intermediate method, and, indeed, whether the operation be done for the purpose of relieving dyspnea or as a preliminary step to surgical invasion of the pharynx, larynx, etc. The tube most generally employed is the one known as the *Luer* tube (Fig. 258), which is a double one permitting of removal of the inner cannula for the purpose of cleansing it. The shield is furnished with two slits which permit of the attachment of tapes, by means of which the cannula is held in place. Fig. 259 shows the means of holding the apparatus in place, and also shows the position the patient should be placed in after the operation is completed. Tracheotomy done for relief of obstructive inflammation requires assiduous attention to the details of after-treatment. The number and character of inspiratory efforts are the guide as to efficiency of the measure of relief. The lumen of the cannula must be kept free at all times, and an attendant must be constantly on watch in order to correct any fallacy in this regard.

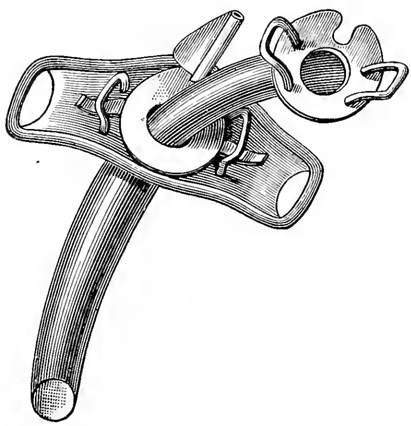


Fig. 258.—*Luer's* Double Tracheal Cannula. (*von Bergmann.*)

When evidence of obstruction occurs the inner cannula is immediately removed and cleansed by means of wet sterile gauze, pushed through it with a bent probe. If the dyspnea is not relieved by this means, the outer tube must be removed, cleansed, and reinserted. The latter measure is rarely necessary. How-

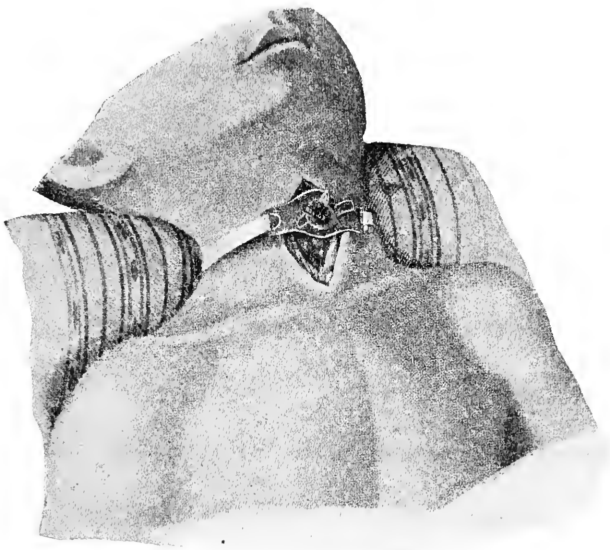


FIG. 259.—TRACHEOTOMY TUBE IN PLACE, AND POSITION OF PATIENT AFTER TRACHEOTOMY. (*von Bergmann.*)

ever, it does at times occur that dried secretions accumulate over the end of the outer tube, and these must be removed to free the cannula.

One of the causes of unfavorable outcome following tracheotomy is due to the absence of the normal amount of moisture contributed to the inspired air in its passage over the mucosa of nose, mouth, and pharynx. Moist air is an important means of preventing the drying of secretions in the cannula. For the purpose, the bed is covered with a hood and the bedclothes covered with waterproof material. A croup kettle is located near the bed with the nozzle led beneath the hood. Various medicinal agents have been added to the water, which become vaporized when the mixture boils and are supposed to contribute to the beneficial effect of the moist air. It is probable that the latter is the important consideration, though there is no objection to the addition of medicinal agents, provided that some non-irritating substance be used.

If obstruction occur after the inner tube has been removed, a soft catheter may be introduced through the inner tube and suction made with a syringe. This measure should not be employed as a routine, but only in the event of the failure of the removal of the inner tube to relieve the obstruction.

The entire apparatus should not be removed if avoidable for three days following its introduction, *i.e.,* until a distinct tract has been formed in the wound. Reintroduction at an earlier period may be attended with unsurmountable difficulties. In any event, the patient must be postured in the same way as for tracheotomy, and the edges of the tracheal wound held open with hooks. If, for the reasons stated, the tube must be removed before a tract has been formed, the same precautions must be taken.

When changing the tracheotomy tube no time must be lost before the second one is introduced, as the tracheal wound contracts very rapidly. For the purpose it is wise to introduce into the wound at once a suitably sized rubber catheter and slip the new tube into place over it. Ultimate decannulement should be performed when the air passes freely through the larynx. The average period when this can be done in cases of diphtheria is from the sixth to the tenth day. When the tracheotomy has been done as accessory to operations involving the upper air passages, a shorter period of time may be allowed to elapse.

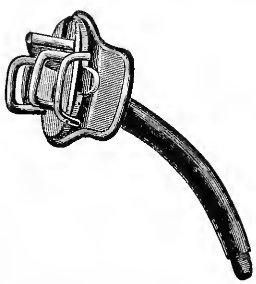


FIG. 260.—CANNULA USED FOR CONVALESCENTS AFTER TRACHEOTOMY. (*von Bergmann.*)

Cannulas which have openings in them are best used for this reason. This permits of removal of the inner tube and its replacement with an inner tube furnished with an obturator. Fig. 260 shows a tube which has been used by *v. Bruns* for years. The inner tube is not pervious and reaches somewhat beyond the outer one. This allows the air to pass without difficulty, and should the patient develop obstruction, it can readily be removed and the pervious inner tube substituted. If the patient sleeps quietly for two nights with the impervious tube *in situ,* the permanent decannulement may be made.

When the tube is permanently removed, the wound usually closes in a few days. While the tube is *in situ* the skin contiguous to the wound should be kept covered with 5 per cent. sterile iodoform in vaselin to prevent excoriation and eczema, due to the presence of secretions.

Following tracheotomy for removal of foreign body, the elaborate after-treatment is regarded as unnecessary. In some cases the tube is not introduced and the tracheal wound closed with suture and the superficial wound drained. However, it is recommended that if the tube be used, provision for moistening the inspired air be made. It is a small matter, and may obviate disagreeable if not dangerous complications. The use of a gauze apron moistened with water and placed over the tracheotomy tube opening is a procrastination, as it cannot fill the purpose. Emphysema of the soft parts of the neck occurs when the tube is dislodged from the trachea by coughing or as the result of unskillful manipulations on part of the attendant. The condition itself is not serious, but may necessitate the secondary introduction of a longer tube which reaches beyond the tissues swollen by the presence of air. This, of course, is likely to occur only before a canal has been formed by the tube, and argues for not changing the tube for the first few days following the operation.

Pressure necrosis from the tube is a common complication. A properly fitting tube tends to prevent this complication. When ulceration occurs the mucus expelled from the tube is streaked with blood. This should be regarded as evidence that the tube is not appropriate for the case, and a proper one should be speedily substituted.

After permanent decannulement the care of the wound is a simple matter. The dressing is changed every other day until healing takes place. At times a sinus leading to a necrosed area of tracheal cartilage persists for a considerable period of time, but this usually heals without interference. The healing may be hastened by painting the sinus wall with tincture of iodin every second day for several sittings.

LARYNGECTOMY

The high mortality rate following laryngectomy has been due to infection, the result of the invasion of the stump of the trachea by saliva and mucous secretions from the mouth and pharynx, which are, of course, more or less infected with bacteria. The infection extends to the lung, and a so-called deglutition or aspiration broncho-pneumonia carries off the patient. While the modification of technic recently employed, which involves isolation of the respiratory tract by fastening the stump of the trachea to the skin, has quite eliminated this element of danger, septic cellulitis in the deep tissues of the neck, with extension to the mediastinal and pleural cavities, still remains as a menacing complication during the postoperative period.

When the tracheal stump is fastened to the skin by suture and furnished with a suitable cannula (Fig. 261) the care of the patient is in all respects similar to that described under tracheotomy, as far as modification of the inspired air is concerned (page 381 *et seq.*) As far as the infective complications are concerned, *Bryant* suggests that the patient be taught to swallow while in the *Trendelenburg* position before the operation is begun. Patients afflicted with disease calling for so radical a measure as complete laryngectomy will be found willing to undergo the discomfort incumbent upon this training. During this time the mouth and pharynx are frequently cleansed, as already described (page 362).

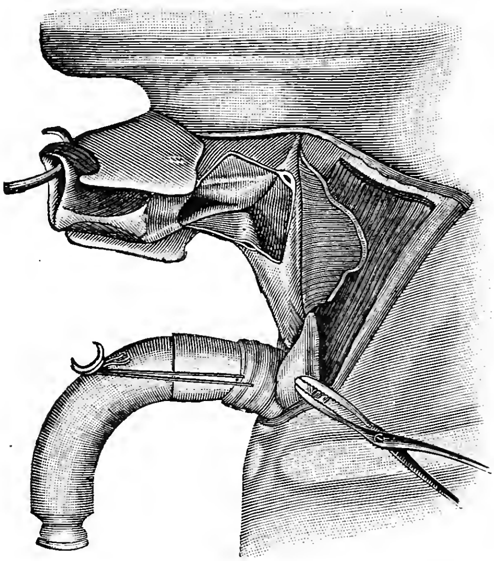


FIG. 261.—*Perier* CANNULA USED AFTER LARYNGECTOMY. (*von Bergmann.*)

The wound is usually only partially closed when the extent of the disease has necessitated removal of the epiglottis and the mucosa, rendering suture of the tracheal stump to the latter membrane impracticable. In the former class of cases the danger of infection is obviously greater than obtains in the latter. Immediately after the operation the wound is packed with gauze, the patient is placed in a position with the head dependent, to facilitate drainage, and the attendant frequently cleanses the mouth in the manner described under operations in the latter situation.

Rectal feeding every sixth hour and saline enema every third hour are employed. The gauze packing is changed twice or three times daily. This latter step causes much discomfort if clumsily executed, and the anticipation of the impending distress has an exceedingly depressing influence upon the patient's general condition. The suggestions already stated with regard to light packing and gentle removal of the gauze should be adopted. It is not amiss to soak the gauze in sterile potassium permanganate and change the packing before the moisture is sufficiently absorbed to permit of agglutination to the surfaces of the wound. If, because of excessive secretion, lavage of the wound surfaces is indicated, the patient's head is still farther lowered and the cleansing is made by introducing gently into the lower portion of the wound a sterile soft catheter connected with a syringe. The apparatus shown in Fig. 251 will be found serviceable for the purpose. The patient holds the mouth over a basin and the fluid enters from below and runs out above between the lips. If vomiting has occurred immediately following the operation, the gauze should be removed as soon as the vomiting ceases and lavage made in the manner indicated. When gastric alimentation is begun, sterile food is administered by means of a sterile catheter passed into the esophagus.

Following the third day after the operation the patient should attempt to swallow small quantities of sterile water. Moderate pressure with the fingers against the outer surface of the neck will facilitate the effort, and, indeed, the training the patient has had in swallowing while in the *Trendelenburg* posture will be found to have been of value.

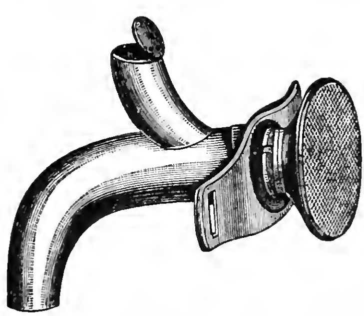


Fig. 262.—*Gussenbauer's* Artificial Larynx. (*Bryant.*)

As regards the wearing of an artificial larynx, suturing *in situ* of the trachea to the mucosa of the epiglottis, of course, does not call for any apparatus, phonation being accomplished with the tongue and lips. When the stump of the trachea is not fastened to the skin, *Gussenbauer's* artificial larynx (Fig. 262) will be found serviceable. This apparatus may form the basis of one which, no doubt, will need some modification in construction to suit the

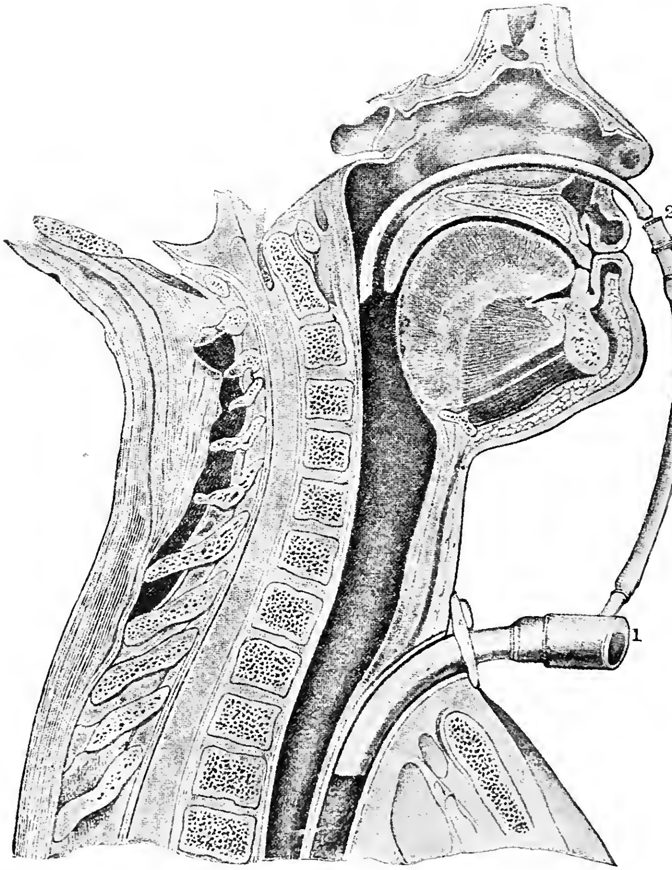


FIG. 263.—*Glück's* PHONATION APPARATUS IN PLACE. 1, Cup with Valve; 2, Voice. (*von Bergmann.*)

individual case. When the stump of the trachea has been fastened to the skin, a measure now quite universally employed, the apparatus of *Glück* (Fig. 263) has given satisfactory results. The illustration explains itself. It may, however, be stated that only a limited number of patients find the use of an artificial speaking apparatus of service. It is probable that an apparatus such as

Glück's will be found the least objectionable. The other forms of apparatus expose the patient to the entrances of pharyngeal secretions into the air passage, a danger from which a valvular attachment to the upper segment of the tube does not give security. No effort should be made to introduce an apparatus until the wound is quite healed, which requires between five and six weeks.

The posture maintained by the patient with the head lowered should be insisted upon for at least five days following the operation. During the healing process the gauze packing will be found to be slowly dislodged by the granulation tissue, and ultimately only a small drain need be inserted into the lower portion of the wound. This latter may be discontinued as soon as it is evident that the deep wound is healed. Unnecessary prolongation of the packing will cause the maintenance of a fistula, which may not close for months.

Patients should be guarded against the entrance of dust into the trachea when convalescence has been established. The wearing of a gauze apron, held in place by tapes, will be found serviceable for the purpose.

THYROIDECTOMY

After either partial or complete thyroidectomy the persistent oozing of blood usually requires tamponade of the wound for two or three days following the operation. This is, of course, not necessary in all cases, and, indeed, the wound may in some instances be closed and dependent drainage made, which may be removed in two days, if no evidence of infection develops. When tamponade has been made the pressure upon the recurrent laryngeal nerve, the phrenic, the pneumogastric nerves, and the trachea must be considered in connection with symptoms, the result of the presence of the gauze. It is never necessary to make sufficient pressure to produce modification of respiration from pressure on the trachea, but heart symptoms and aphonia or hoarseness may be produced, which might be regarded as the result of injury to nerve fibers, which, as a matter of fact, soon clear up when the tamponade is removed. Tamponade for the purpose of arresting bleeding need not be left *in situ* longer than forty-eight hours, and the tampon (preferably, for the purpose, the *Mickulicz* tampon should be used) may then be removed.

At times a hematoma forms if the packing has been omitted, which gives rise to pressure symptoms, though these disappear when the blood clots are expressed or dislodged with a saline irrigation or the same solution introduced through the drainage opening by means of a syringe. At times a kinking of the atrophied trachea, which latter condition is the result of prolonged pressure on the trachea, causes severe dyspnea. This is corrected by extending forcibly the head and maintaining it persistently in that position.

Dyspnea following thyroidectomy has been caused by the accumulation of saliva in the upper segment of the pharynx due to paralysis of the esophagus. However, this condition of affairs is exceedingly rare and may be obviated by lowering the head of the bed, allowing thus of discharge of the saliva and its expulsion from the mouth either by gravity or as the result of voluntary expectoration.

The rise of temperature following removal of the thyroid gland is not necessarily ascribable to infection nor, indeed, to absorption of ferments. In almost all cases of thyroidectomy a sharp pyrexia follows the operation. This disturbance of metabolism has been attributed to absorption of portions of glandular elements coming in contact with a large surface of tissue subjected to trauma, and is clinically differentiated from the rise of temperature due to infection, inasmuch as the latter (infection) is accompanied by the concomitant symptoms due to the infection, such as increase of pulse rate and the local symptoms of inflammation, pain, etc., while the pyrexia due to absorption of glandular elements is a solitary symptom not accompanied by the clinical picture, the outcome of the invasion of bacteria.

Pneumonia occurs as a part of sepsis, but is also due to paralysis of the larynx due to injury or pressure on the recurrent laryngeal nerve. In the latter instance, the pneumonia may be regarded as an aspiration pneumonia and belongs to the class of lung inflammations following tracheotomy. Hoarseness or aphonia following thyroidectomy is an indication for employment of the precautions with regard to the inspiration of moist air, described under the head of tracheotomy (page 381), and removal of packing or the blood clots of a hematoma at as early a period as is consistent with the other symptoms. If infection of the wound occurs, the care and treatment of the wound is in all respects similar to that which obtains in other situations of the body. It is well to reiterate in this connection that early drainage of the infected area is especially indicated here because of the danger of rapid invasion of the mediastinum and pleural cavities (page 376).

Tetany and chronic myxedema have been considered as two distinct afflictions following thyroidectomy and due to removal of the gland. At this time they are regarded as degrees of the same condition.

Acute myxedema is now quite rare, as experience has taught that it may be prevented by leaving behind a portion of the gland or an accessory gland. The symptoms of this condition appear either immediately after the operation or may develop several days later (up to the tenth day). Prodromal symptoms, such as restricted motion or rigidity of the muscles of the extremities, occur. *Chvostek's* sign—that of a fulminating contraction of the face following a tap over the facial nerve—or *Trousseau's* sign—that of a spasmodic contracture of the muscles of an extremity following pressure upon one of the main arteries or nerves supplying the limb—together with the occurrence of the stiffness of the muscles mentioned, may make the diagnosis easy.

As the affliction develops, the entire body becomes progressively tetanic. There is little, if any, disturbance of temperature during the attacks and the sensorium remains clear. The prognosis of this condition is exceedingly unfavorable. It is worthy of note that the intensity of the postoperative manifestations in this regard bears a direct proportion to the amount of gland tissue left *in situ*.

Chronic Postoperative Myxedema is manifested by diminished mental activity and edematous swelling of the skin. For complete description of the symptomatology, the reader is referred to works on the principles of surgery. In this connection it is proper to state that the clinical picture is the result of the absence or destruction of normal thyroid tissue, a deviation from the original intent of this work justified by the fact that it is this which presents the most important indication for postoperative treatment.

Treatment of Tetany and Cachexia after Thyroidectomy.—As already stated, the fact that, as a rule, the symptoms mentioned do not occur when a portion of the gland is left behind points the way with respect to treatment. It must be borne in mind that the residual amount of glandular tissue may not suffice to furnish the necessary elements to the processes of metabolism, and, again, the character of the diseased process for which thyroidectomy is undertaken may preclude leaving any of its tissue behind, and, again, it is not impossible that the changes in the gland may be such that the portion left behind does not functionate sufficiently for the purpose.

It may be stated that the introduction of thyroid tissue into the system obviates the occurrence of unfavorable manifestations. The injection method, while effective, should only be employed when the prodromic symptoms of tetany described above are elicited, and the introduction by mouth of desiccated thyroid extract, now obtainable in the market, should be used in all cases whether symptoms arise or not. To summarize, inject extract of thyroid if the entire gland has been removed and there be the slightest indications of tetany. Give desiccated extract of thyroid in all cases. When the acute symptoms of myxedematous tetany subside, discontinue the injections and give the preparation by the mouth. In all cases begin treatment as soon after the operation as possible, and maintain it for a long period of time.

If, by reason of the urgency of the indications, thyroid extract is introduced by injection, a long needle and roomy syringe barrel should be used. The illustration shows an instrument which is serviceable for the purpose (Fig. 264). The injection is preferably made into the gluteal muscle. The thyroid extract is mixed with sterile water, using about five grains of the desiccated extract in a half dram of water; this is sucked up into the barrel, and the needle is introduced into the buttock before the connection is made. The protruding portion is watched for hemorrhage, the absence of which indicates that a vein has not been entered. The barrel is now connected to the needle, and the injection slowly made. The skin should be first wiped off with denatured alcohol. Local re-

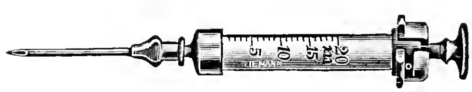


FIG. 264.—RECORD SYRINGE, BARREL OF GROUND GLASS WITH METAL PLUNGER AND LONG NEEDLE; USEFUL FOR DEEP MUSCULAR INJECTIONS.

action does not occur if these instructions are followed. The injection may be repeated at six-hour intervals until the patient is in condition to take the preparation by mouth. Tablets of five grains each are taken after meals. The dosage varies with the indications, being increased, if necessary, to fifteen grains three times daily. This dose may give rise to cardiac disturbances (tachycardia), demanding reduction in the size of the dose. The treatment must be carried on for years unless a regeneration of the portion of gland left behind becomes commensurate with the demands of metabolism. Interruption of the treatment is invariably attended with return of symptoms, which promptly disappear upon renewal of the administration, unless the conditions just mentioned obtain.

It is generally regarded wise to limit the amount of meat taken by the patient. This should involve no special hardship, and while its rationale is not clearly apparent, the precaution is advised on general principles.

EXOTHYROPEXY

Exothyropexy (*Jauboläy, Poncet, Berard*) is not generally employed. It consists of delivering the thyroid out of the superficial wound and permitting it to strangulate. The after-treatment does not differ from that of thyroidectomy except that the temperature symptoms are more marked, and that, for obvious reasons, infection is more liable to obtain. The exposed goiter must be dressed every day. The first few days after the operation the gland discharges copious amounts of clear fluid (goiter sweats). This necessitates more frequent changing of dressings. The method is not regarded as a desirable one.

DRAINAGE AND PACKING OF CYSTS OF THE THYROID

Drainage and packing of cysts of the thyroid are practiced when the neoplasm makes pressure. The measure is used upon elderly persons in whom the radical excision is contraindicated.

Simple drainage does not often achieve obliteration of the sac. The drainage material is left *in situ* until forced out by the proliferating scar tissue.

Packing more frequently achieves the purpose. The packing is changed every second day. Care must be taken to obviate the occurrence of infection. The cavity may be syringed out with a mild solution of iodin, a few drops to the pint of water, with the view of stimulating repair and preventing infection. At longer intervals the cavity may be painted with the pure tincture of iodin, though this had best be done after considerable contraction of the cyst cavity has taken place. The injection of hydrogen peroxid is permissible, with the view of facilitating removal of the gauze tamponade, as the cyst does not communicate with the deep fascial spaces of the neck. If the cyst extends to behind the sternum, care should be exercised with respect to the accumulation of cleansing fluids in its dependent portion, as forcible tamponade may rupture the cyst wall and distribute the contents into the mediastinum. Especially should this be guarded against if suppuration occurs. In the latter instance the cyst should be emptied by suction with a syringe connected to a soft rubber catheter, which is introduced through the wound. Thereafter gauze wick drainage should be introduced well to the bottom of the poststernal cavity, and the end of the drain should be permitted to escape beside the tamponade occupying the rest of the cavity. Entire obliteration may ultimately be obtained in this way. When total excision of thyroid cysts has been accomplished the after-treatment does not differ in any essential regard from that described under thyroidectomy.

ESOPHAGOTOMY

Cervical esophagotomy does not call for special local preparation. The fact that the manipulations are carried on contiguous to the apparatus employed for narcosis suggests that provision should be made for sterile narcosis (page 311). The administration of sterile diet, while indicated, is probably not applicable, as the operation is usually undertaken to overcome obstruction, a condition which, of course, precludes the introduction of food. Rectal alimentation should be maintained until just before narcosis is begun. The last enema may contain stimulants which are designed to combat shock. The usual preparations for the hypodermic administration of stimulants should be made, especially as the exhaustion due to lack of proper nourishment predisposes to collapse. Thirst is a marked symptom of esophageal obstruction. A high saline enema given soon after the operation will tend to overcome this distressing manifestation. Introduction of food with the stomach tube may be begun forty-eight hours after the operation, though care must be taken to sterilize the tube and to introduce it with gentleness, especially if an effort has been made to obtain primary union in the esophageal wound. The introduction of food into the stomach should not be begun until a reasonable certainty exists that the postoperative vomiting has ceased. It is obvious that soiling of the wound surfaces with the contents of the stomach is objectionable.

The care of the wound after esophagotomy varies slightly with regard to whether the esophageal wound has been closed by suture or not. It is probable that complete closure of the wound is unwise. Contamination during the operation may be avoided, but, as already stated, the vomited matter which is almost invariably discharged after an operation is likely to infect the wound. In some instances the wound in the esophagus is closed and the wound in the neck freely drained. In either case cleansing of the wound should be practiced at the end of the postoperative vomiting, with the view of lessening the chances of infection.

If the esophageal wound has been left open this step would seem very necessary, which, indeed, is the case. However, on the other hand, the fact that the wound is open will permit of more satisfactory cleansing, and the attendant has more assurance that infective material is not so likely to burrow in the deep fascial spaces. It is a good rule in surgery to provide for free access to surfaces which are liable to infection or are to be subjected to manipulations. If the esophageal wound has been closed, the presence of minute portions of material which may have leaked into the surrounding tissues may escape notice and a fallacious complacency be engendered which may lead to unfavorable results. It is also well to bear in mind that saliva is more or less continuously passed down the esophagus, and this constitutes an element of danger in the respect mentioned. In order to lessen the infective character of the saliva, frequent liberal lavage of the mouth with boric acid or similar solution should be made. The patient will regard the latter measure as a very satisfying one, as thirst, if not relieved by it, is less distressing because of it.

The initial dressing should not remain *in situ* more than twenty-four hours, even though vomiting does not occur, and, indeed, cleansing of the wound should be done twice daily for four days after the operation. Feeding with liquid food may be carried out at each dressing, and all foreign matter removed from the wound immediately thereafter. The liquid food should be sterile (page 430), for obvious reasons.

The wound in the esophagus heals usually in ten days. The administration of solid food should not be begun until there be reasonable assurance that the esophageal wound is closed.

CHAPTER XIX

OPERATIONS ON THE THORAX

Excision of the Breast—Thoracotomy—Thoracoplasty—Decortication of the Lung—Resection of Large Surfaces of the Thoracic Wall—The Deformity.

EXCISION OF THE BREAST

The special local preparation for excision of the breast relates to shaving the axilla and thoroughly cleansing of the skin of the thorax, neck and arm of the patient.

Excision of the breast for malignant disease contemplates removal of tissues, including the lymphatics concerned in draining the mammary gland, a procedure involving invasion of large areas of tissue, a factor which calls for especial care in the observance of antiseptic precautions before, during, and after the operative procedure. As hemorrhage is likely to be severe during the operation, a liberal number of gauze sponges and a large number of towels should be available.

When the excision is followed by complete closure of the wound the local after-treatment does not differ from that employed elsewhere, except that retention sutures (page 215), Figs. 179 to 184) are frequently introduced.

Drainage from the dependent portion of the wound, which corresponds to the lower part of the axillary flap, is also introduced in the majority of cases, the withdrawal of which is governed by the same rules applied elsewhere (page 186). In this situation the oozing of blood may obstruct the drainage tube, and while the dressing should not be unnecessarily disturbed, it should be changed at the end of twenty-four hours if there has been much oozing immediately subsequent to the operation, with the view of removing the tube and reëstablishing its patency when it may be again introduced, or better still a fresh tube may be inserted in its place. The wound may then be redressed and the subsequent changes of dressings be governed as to frequency by the indications, as already stated. After radical excision for malignant disease of the breast, the wound presents the appearance shown in Fig. 265. The drainage tube is seen to emerge from an incision made at the dependent portion of the subcutaneous wound, through the latissimus dorsi muscle. The retention sutures held by buttons are also shown. If, however, it has been impossible

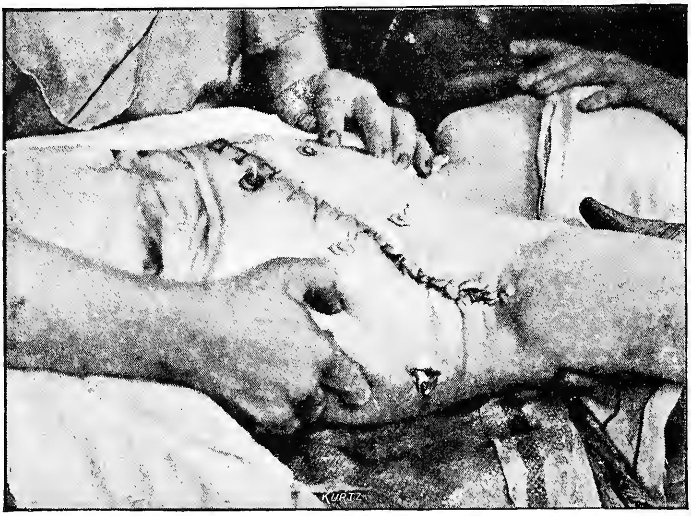


FIG. 265.—APPEARANCE OF WOUND AFTER EXCISION OF BREAST. (*Gerster.*)

to bring into apposition the edges of the wound because of the involvement of large surface of skin, a portion of the wound is left to heal by granulation. This calls for slightly different measures in the after-treatment.

It is believed by some observers that malignant disease recurs more frequently after operations when the ultimate repair is attended with healing by granulation and suppuration than obtains if primary union follows the operation. A discussion of the cellular activity consequent to the formation of granulation tissue does not belong here. It is mentioned, however, to emphasize the need of preventing infection in the care of wounds which heal by granulation. The surface not covered by skin is lightly packed with iodoform gauze, and this is changed at intervals of forty-eight hours. Each dressing is made under strict aseptic precautions, the field being surrounded with sterile towels and the attendant prepares the hands and instruments in the usual manner. When the granulations have reached the skin level, the treatment of the wound should not be left to the patient, but the precautionary measures mentioned must be persisted in until the wound is entirely closed. The healing process will be conserved by strapping the wound with adhesive plaster, which is affixed in such a manner as to draw the edges of the raw surface together. The adhesive strips should not cover the entire surface of the wound, but should leave sufficient space on either side to permit of drainage.

The Dressing.—A liberal amount of fluffed gauze should be placed next the wound (Fig. 188) to absorb the discharges, which in these cases, as already stated, is likely to be considerable in quantity. The method of holding the protective dressing in place varies at the hands of the operator. The immobilization of the arm contiguous to the operation conserves repair and relaxes tension. On the other hand, this method of bandaging causes disuse, atrophy, and partial, more or less persistent ankylosis of the shoulder joint and favors cicatricial contraction, which ultimately limits the amount of motion in the limb.

FIG. 266.—CUIRASS TO HOLD DRESSINGS IN PLACE AFTER REMOVAL OF BREAST. (*von Bergmann.*)

For this reason it is best not to attempt a display of the art of bandaging, but to retain the protective dressing with a sort of "cuirass," which permits of free motion of the limb. The kind of retention dressing which is of great service in this connection is shown in Fig. 266. It will be seen that the retention apparatus covers entirely the field of operation including the subclavian triangle, which latter is frequently invaded in operations of this sort. It also covers the insertion of the major pectoral muscle and at the same time allows of free motion of the arm. In addition to this, the "demi-waist" is fastened behind and presents a smooth surface in front, a factor which contributes to its serviceability to a not inconsiderable degree. This demi-waist is readily made by a seamstress or an adroit nurse, and is constructed of unbleached muslin. It is best furnished with tapes set closely together, which are attached behind and permit of some elasticity with regard to adjustment. Safety pins are apt to exert uncomfortable pressure when the patient is in the supine position.

During the postoperative period it is well to encourage the patient to use the arm as much as is consistent with comfort, though no such effort before the sixth day should be encouraged. After this time passive motion while the wound is exposed should be made, and later, at the beginning of the tenth or twelfth day, the patient should begin making muscular efforts.

If the postoperative course is uncomplicated, the drainage may be permanently removed on the fourth day after the operation. The retention sutures should be taken out on the seventh day, and the apposition sutures removed on the tenth day. If infection has occurred, the retention sutures are left *in situ* and the apposition sutures removed as the indications arise, removing those which interfere with thorough lavage and cleansing of the wound. The retention suture may remain in place for fourteen days when infection has occurred, with the view of obviating gaping of the wound surfaces.

The treatment of an infected case does not vary from that of those cases which did not permit of complete closure of the wound at the time of the operation. Radicalism with regard to free incision and dependent drainage should be observed. The attendant need hardly fear on the side of the latter proposition. It is to be borne in mind that a large surface of the body has been subjected to trauma, and that a considerable area of wound surface is in a condition to present an avenue of absorption for the products of infection, and that systemic invasion is exceedingly liable to occur. For this reason the admonitions just presented are submitted.

THORACOTOMY

The special preparation for thoracotomy should take cognizance of the fact that narcotics have a depressing influence upon respiration, and that the oxygenation of the circulating fluid is already seriously embarrassed because of the condition for which thoracotomy is undertaken. The attendant should have a tank of oxygen close at hand and be prepared to make artificial respiration. For the latter purpose the Fell-O'Dwyer apparatus, as modified by *Fell,* will be found useful. (Described on page 409 *et seq.*) Embarrassing complications may be avoided if this apparatus be at hand.

The patient should be postured in such a manner as to allow of free expansion of the sound side of the thorax. The narcosis should be limited to as short a period of time as possible, and all preparation for operating should be made, with the view of obviating delay.

Simple incision of the intercostal space for drainage of the pleural cavities does not permit of the ready removal of fibrinous exudates, nor does it allow of prolonged maintenance of drainage, for the reason that as the chest wall contracts an over-riding of the ribs contiguous to the incision and closure of the wound is likely to occur. However, the measure is employed in children and feeble persons, and with care in the after-treatment the wound may be kept sufficiently patent to achieve sufficient relief to, perhaps, permit of more radical measures at a later period.

After the incision has been made, an ordinary large-sized metal tracheotomy tube (Fig. 258) is introduced into the pleural cavity and fastened with tapes about the chest. The tube may be cut off at its intrathoracic end to suit the purpose. Care should be taken to see that the plate guard of the tube lies flat upon the thorax. A rubber tube may be passed through the metal one for purposes of drainage or suction. The metal tube should be removed only at long intervals if at all, as the ribs will encroach upon the space at once when it is withdrawn. The after-treatment following this method of drainage is in all respects similar to that employed following resection of a rib. Fig. 267 shows the tracheotomy tube *in situ* held by tapes.

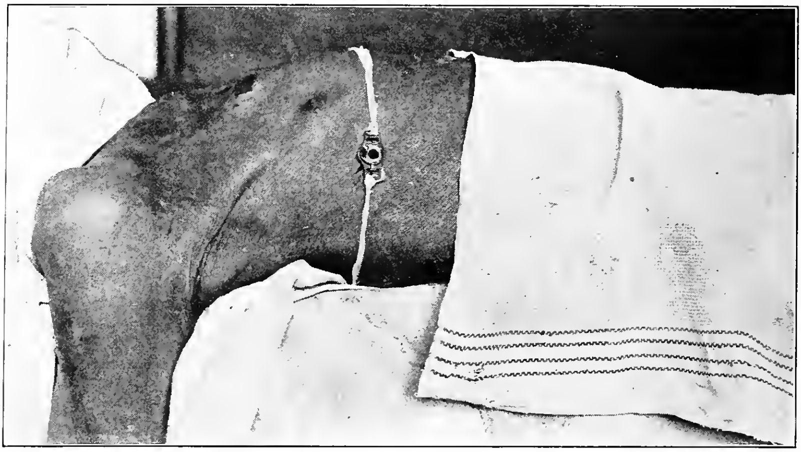


FIG. 267.—METHOD OF DRAINAGE OF PLEURAL CAVITY AFTER SIMPLE THORACOTOMY.

Excision of part of a rib permits of more liberal drainage and removal of fibrinous exudate. After discharge of the contents of the pleural cavity, tube drainage is introduced and the distal ends of the wound closed by suture. Silkworm gut sutures are most commonly employed for the purpose, for reasons already indicated with regard to infected wounds. When the operation is finished, the wound presents the appearance shown in Fig. 268.

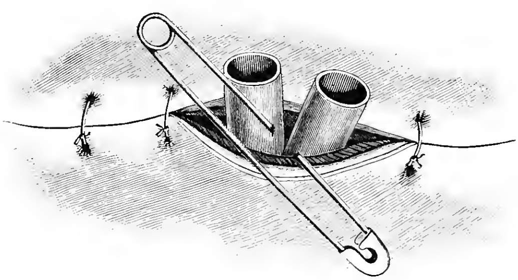


FIG. 268.—WOUND WITH DRAINAGE TUBES AFTER THORACOTOMY. (*Bryant.*)

The dressing should consist of a large quantity of antiseptic gauze, preferably fluffed (Fig. 188), as this form of dressing enhances absorption of the discharges. The dressing should be changed every day for several weeks, and may then be changed every forty-eight hours. Care must be exercised in manipulating the drainage tubes, that they do not slip into the pleural cavity, and in each instance the safety pin should be affixed, as shown in the illustration, to prevent this accident between dressings.

The after-treatment of thoracotomy for purulent pleural inflammation is a long and tedious procedure. Favorable outcome is only to be expected as the result of patient application of measures of relief. Drainage should be maintained until the discharge ceases, or at least until only a serous exudate small in quantity persists, which is the result of the presence of the tube. Too early interruption of the drainage will result in closure of the superficial opening and reaccumulation of the exudate. When the tube is removed, it is best to place into the opening several strands of silk-worm gut (Fig. 147), which may be gradually lessened in number until final healing takes place.

Aspiration with drainage following thoracotomy promotes expansion of the lung and obliteration of the empyemic cavity. *J. D. Bryant* has devised an apparatus for this purpose which

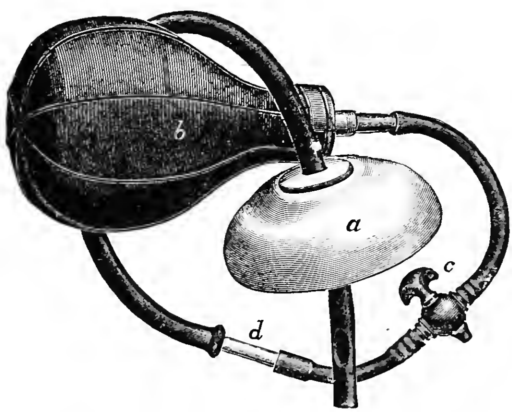


FIG. 269.—*Bryant's* ASPIRATION APPARATUS. *A,* Hollow rubber cushion; *B,* Distended rubber bag; *C,* Stopcock; *D,* Glass observation tube.

has proven of singular service in cases under the observation of the writer. The apparatus (Fig. 269) is described in the language of its inventor.

The end of the tube projecting beneath the cushion (a) is passed into the empyemic cavity the proper distance, and the cushion (a) is placed in contact with the wall of the thorax in such a manner as

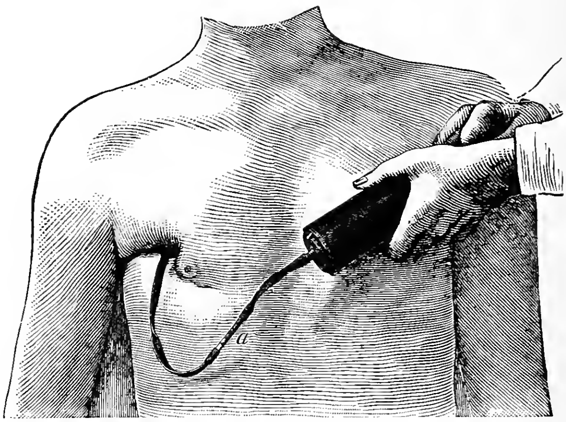


Fig. 270.—Aspiration of Pleural Cavity. *A*, The glass observation tube, showing suction force applied by syringe. (*Bryant.*)

to command equally the area surrounding the opening into the pleural cavity. The nozzle of an ordinary syringe is then inserted into the distal end of the tube (Fig. 270), the liquid withdrawn, followed

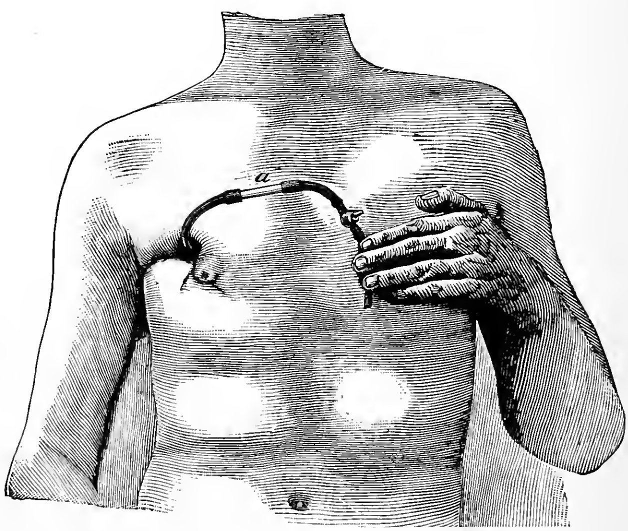


Fig. 271.—Aspiration of Pleural Cavity. *A*, Segment of glass tube. Cavity aspirated and stop-cock closed to prevent admission of air. (*Bryant.*)

finally by sufficient exhaustion of air to cause the rubber cushion to fit closely enough to the chest wall to prevent the passage of air beneath it into the pleural cavity. The stop-cock is then closed (Fig. 271), the syringe removed, and the nozzle of the rubber bag (Fig. 271), while fully collapsed, is inserted firmly into the open end of the tube (Fig. 272), the stop-cock reversed, thus establishing aspiration, which is

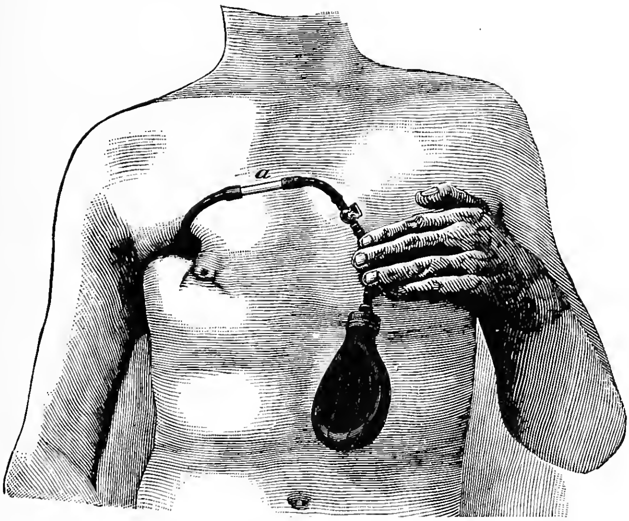


Fig. 272.—Aspiration of Pleural Cavity. The Collapsed Rubber Bag Attached and Stop-cock Opened. *A*, Glass observation tube; the apparatus in action. (*Bryant.*)

maintained so long as the bag is expanding. The chest is then dressed and the apparatus duly fastened into place as indicated in Fig. 273. The patient can go about comfortably with the apparatus in action without attracting special attention. When the bag is nearly distended, the stop-cock should be closed, the bag cleansed, again collapsed, reapplied and the stop-cock opened.

If brisk and forcible aspiration by the syringe be made, the tube will collapse (Fig. 270), and often the discharge will be tinged with blood, which can be noted through the glass segment of the tube. Continuous and mild aspiration is safer and quite as effective as the vigorous, in the vast majority of instances. The degree of distention of the bag should be frequently observed in order that it may be removed, cleansed, and reapplied without interruption of aspiration. Adhesive plaster applied to the chest around the opening aids in the exclusion of air. Absorbent cotton, thoroughly wet with boric-acid solution, or rubber tissue hinders the passage of air beneath the cushion. It is very important in this connection to remember that the cotton, or any small movable body, may be drawn into the chest unless care be exercised. Should this happen it can be removed quite readily in most instances by moving around in the cavity the inner end of the tube while making suction on the outer with the syringe.

In the cases to which aspiration has been applied it acted efficiently and promptly, and was easily managed by the patient.

It seems to the writer that practicable aspiration offers the oppor-

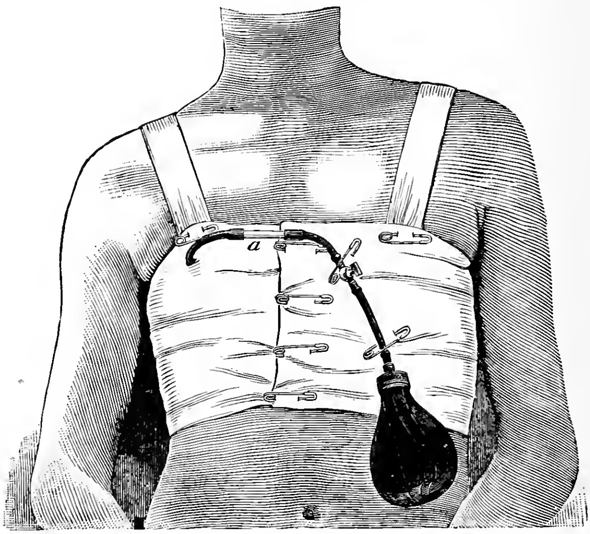


Fig. 273.—Aspiration of Pleural Cavity. *A*, Glass observation tube. The dressing applied; apparatus held in place by safety pins while in action. (*Bryant.*)

tunity of prompter cure in excision cases, and not impossibly may render needless the more serious methods of practice by obviating the conditions that prompt their use. Much contention has arisen in the past regarding its feasibility. The writer notes with regret the seemingly strenuous tenor of these contentions. Cases complicated with gangrene of the lung and abundant fibrinous deposits are certainly unsuited for the immediate use of aspiration treatment. Repeated experience with the simple portable apparatus devised by the author since the writing of the preceding clause has not in any degree lessened his belief in its efficiency, in suitable cases. On the contrary, the rapidity with which, in nearly every instance, the size of an empyemic cavity has been reduced by this simple method of aspiration emphasizes its worth in limiting the often tedious course of this affection in a most decided manner. Now we, in nearly every instance, introduce the tube into the cavity as soon after resection or simple incision as will permit of the tissues being sufficiently tightly drawn around it with adhesive strips to prevent the entrance of air from without. Sometimes over these adhesive strips, aseptic absorbent cotton, wet with boric-acid solution, is packed and confined in place with adhesive strips, before air can be excluded, when suction is applied. In such cases care must be taken to prevent air from forcing fragments of cotton into the cavity. The apparatus has proven decidedly efficient in those cases from which fibrin had been removed or in which not enough was present to obstruct the tube; also, in which the walls of a small cavity or of a sinus were not obstructed from suction. The hollow rubber cushion (Fig. 269, a) is not so secure as the use of adhesive strips. In many instances a glass chamber has been substituted for the glass tube (a) and the fluids collected therein as they were withdrawn by the rubber bag. In two instances the tube was inserted through a cannula deposited between the ribs by means of a fitting trocar, the cannula being removed as soon as the tube was in place. In those instances the tissues pinched the tube closely, especially when suction was applied, and easily excluded the admission of air. The influence of force of aspiration on the dimension of a cavity is best appreciated by occasional measurement through the agency of water, introduced into it with the body always in the same posture. Both antiseptic and aseptic flushings are employed when indicated.

By the apparatus one can determine the presence of minute lung perforations, as then a vacuum is not maintained.

Dr. Bryant informs the writer that he has quite abandoned the use of the rubber cushion in these cases, as it is difficult to obtain symmetrical application of the rubber to the chest wall because of the irregularity of the outline of the latter. In most cases he introduces the intrathoracic portion of the tube, packs the wound and surrounding tissues with absorbent cotton, and seals the surface with collodion. This measure is very effective and may be substituted for the rubber cushion if the latter be found defective in the regard mentioned. Also, it will not be always convenient to obtain the rubber cushion at short notice, and the measure just discussed may be employed until an especially constructed cushion is made, which should, of course, be fitted with the view of obviating the objection mentioned. If a special cushion be made for each case its use should be found effectual for the purpose. The objection, on the other hand, to the cotton and collodion seal is that it is removed with difficulty when the wound is to be cleansed. In this connection the attendant is asked to bear in mind that ether will dissolve the mixture, and its removal will be much aided by its use.

It should also be borne in mind that the most dependent portion of the pleural sac is posteriorly and inferiorly, and that thoractomy is never, if ever, done at this aspect of the chest wall. Thorough emptying of the empyemic cavity is never achieved except as the outcome of suction, and when the dressing is changed, whether the aspiration apparatus has been employed or not, a rubber tube of sufficient length to reach the bottom of the cavity should be introduced and the contents removed by suction. When flushing is employed, the lavage should be made with ample provision for return flow, in order to obviate respiratory disturbance from pressure of the cleansing fluid on the lung.

The cleansing fluid should have a temperature of 105° F., and be introduced with the precautions mentioned. For the purpose *Thiersch's* solution or a normal saline solution, giving due attention to sterility of the agent, may be used. Solutions of corrosive sublimate or carbolic acid should never be employed except in chronic inflammatory conditions which have been freely exposed by thoracoplasty (page 407).

After the return fluid is clear the irrigation is suspended, the cavity is completely emptied by suction, and the aspiration apparatus reapplied. It is preferable to have the patient in the supine position during the lavage. However, when suction is made for the purpose of completely emptying the pleural sac, the patient may be sat up in order to cause gravitation of the fluid contents to the most dependent portion of the cavity and thus permit of its complete removal. During the latter act due care should be exercised to obviate syncope, as lavage of the pleural cavity is not infrequently attended by considerable shock to the patient. Under no circumstances should hydrogen peroxid be used in this class of cases, for obvious reasons.

THORACOPLASTY

The resection of a greater or lesser amount of contiguous ribs, with the view of giving relief of chronic inflammatory conditions of the pleura, does not necessarily involve the use of the agents to obviate interference with respiration, as is the case in operations for more acute processes. This is, perhaps, due to the fact that rarely, indeed, is the entire pleural sac involved, and, as a rule, compensatory dilatation of the opposite air cells has produced a certain respiratory balance. It is wise, however, to be prepared for the emergencies in even this class of cases (page 399).

After completion of the resection the wound, as a rule, is left open and the residual cavity packed with iodoform gauze. The gauze is removed at the end of twenty-four hours and the cavity lightly packed, this procedure being repeated every second day until obliteration of the cavity takes place. As in these cases there is ample provision for egress of cleansing agents, hydrogen peroxid may be used for the purpose, and, indeed, its employment is advised, with the view of loosening the gauze which, in some instances, becomes adherent to the pleura. The cavity may be irrigated with either corrosive sublimate (1-5,000) or carbolic acid 1 in 200 solution. In those cases in which the pleura is much thickened the surface of the cavity may be painted with tincture of iodin with the view of giving rise to moderate inflammation and to stimulate the deposit of scar tissue. This may be repeated every four days.

As expansion of the lung in these cases is not to be expected, and obliteration of the cavity is achieved as the outcome of collapse of the chest wall, the latter should be encouraged by strapping the chest with moderate pressure. The irrigation of the cavity should be done with large quantities of solution, the temperature of which should be about 105° F. The employment of warm solutions has a tendency to obviate the shock attendant upon manipulations in this situation. As the cleansing is made every two days, or possibly oftener, the repeated manipulations are likely to exhaust the patient. A Kelly pad (Fig. 13, page 49) may be slipped under the patient and the surrounding surface of the body protected with blankets, and, indeed, the technic of the procedure should be designed to obviate, as much as possible, discomfort and annoyance to the patient. As soon as it is feasible, the patient should be placed in the open air and the over feeding begun. This is exceedingly important, as not a small number of those afflicted with chronic inflammatory conditions of the pleura are tuberculous.

As soon as convalescence is established breathing exercises and gymnastics should be indulged in. The tendency toward lordosis may be in a measure overcome by the employment of these measures. The application of apparatus designed to correct deformity of the spine must be postponed until the wound is healed. On the whole, the wearing of apparatus to overcome spinal deformity in these cases is of little service unless supplemented by rational gymnastics.

DECORTICATION OF THE LUNG

Decortication of the lung and removal of the parietal pleura limiting the empyemic cavity calls for the same preparation as obtains with the procedures just discussed. As, however, removal of the pyogenic membrane contemplates expansion of the lung and closure of the wound in the chest wall, the after-treatment differs, inasmuch as simple drainage is introduced and the measures designed to promote expansion of the lung are assiduously practiced early in the postoperative care. Packing is, of course, omitted. The measure has not been sufficiently tested to permit of a conclusion with regard to its practicability.

RESECTION OF LARGE SURFACES OF THE THORACIC WALL

Resection of large surfaces of the thoracic wall and invasion of the pleural cavities for disease in these situations, other than inflammatory conditions of the pleural sac, differ with regard to the problem presented inasmuch as in the latter class of cases the lung is already collapsed or displaced to an extent commensurate with the extent of the affliction, while in the former class of cases the lung is still in contact with the thoracic wall, and invasion of the pleural sac or lung produces a sudden collapse of the lung, and death from embarrassment of the respiratory function is likely to occur. The deformity following attack of the thoracic wall for disease of the pleura is the result of collapse of the chest wall. In instances in which the thoracic wall is opened for the relief of disease of the lung itself, healing takes place without marked deformity. Fig. 274 shows a case in which extensive resection of the chest wall was made for gangrene of the lung. It will be seen that there is no collapse of the chest wall and that no spinal deformity has occurred. This applies with equal force to surgical invasion of the lung tissue itself. Certain diseases of

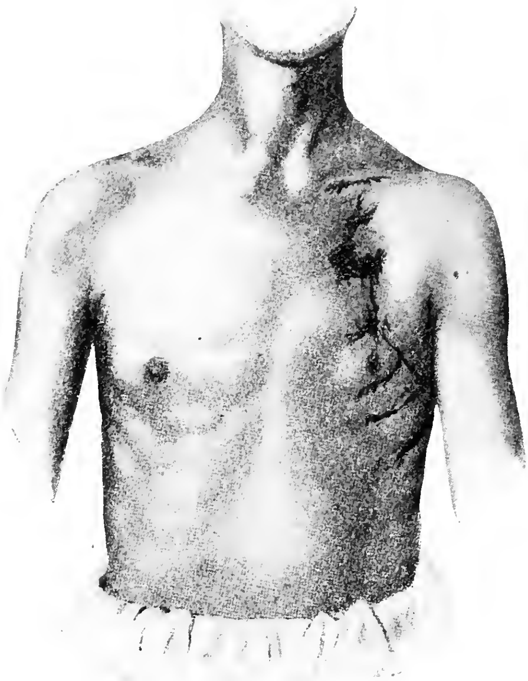


FIG. 274.—APPEARANCE OF CHEST FOLLOWING EXTENSIVE RESECTION OF RIBS, INCLUDING CLAVICLE FOR GANGRENE OF THE LUNG. *(von Bergmann.)*

the lung are regarded as amenable to surgical treatment, and the attendant is expected to have in readiness apparatus which will obviate the danger of collapse of the lung.

The following description is taken from a communication to Dr. *J. D. Bryant* from the originator of the apparatus, *Fell* (Fig. 275), who has improved the original apparatus in the following way:

The apparatus which I have used and found so efficient in cases of forced respiration (Fig. 276) consists of a bellows (a), the size of which has been determined by my experience. It is operated as follows: Three movements for inspiration and three for expiration.

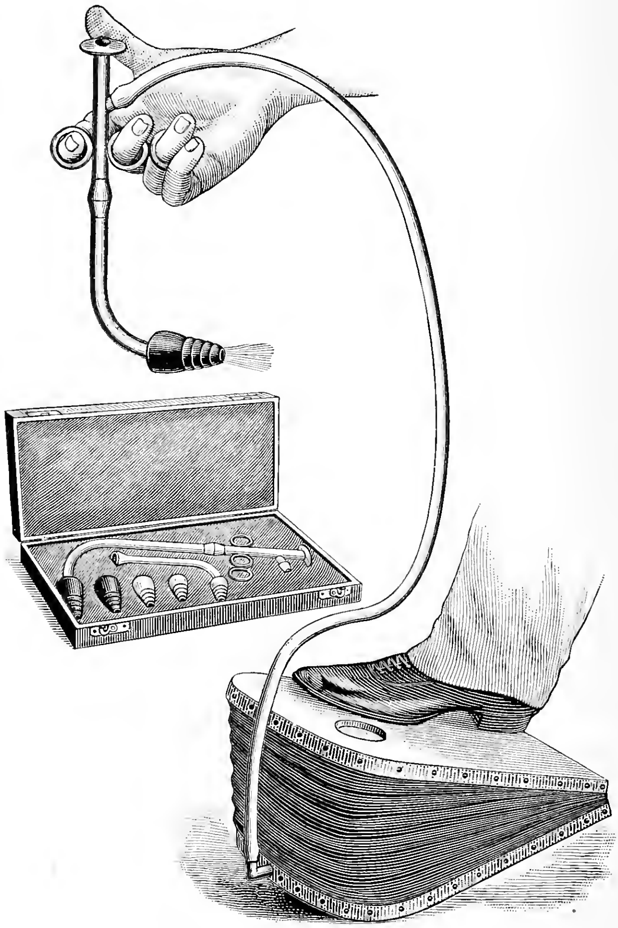


FIG. 275.—The *Fell-O'Dwyer* APPARATUS IN ACTION, SHOWING THE BELLOWS, ASSORTED SIZES OF INTUBATION CONES, AND THE CONDUCTOR. An intubation cone of suitable size is pressed into the larynx so as to prevent the escape of air between it and the laryngeal wall. The bifurcated arrangement of the conductor regulates the amount of air introduced by means of the thumb acting as a valve at the point of escape. (*Bryant.*)

This will produce eighteen or twenty respirations per minute when worked at a convenient rate of speed. The attempt to operate it so that a single movement represents an inspiration would almost certainly defeat the purpose for which the apparatus is intended. The anesthetic can be administered by placing a sponge or gauze, properly saturated with the anesthetic, over or in proximity to the open-

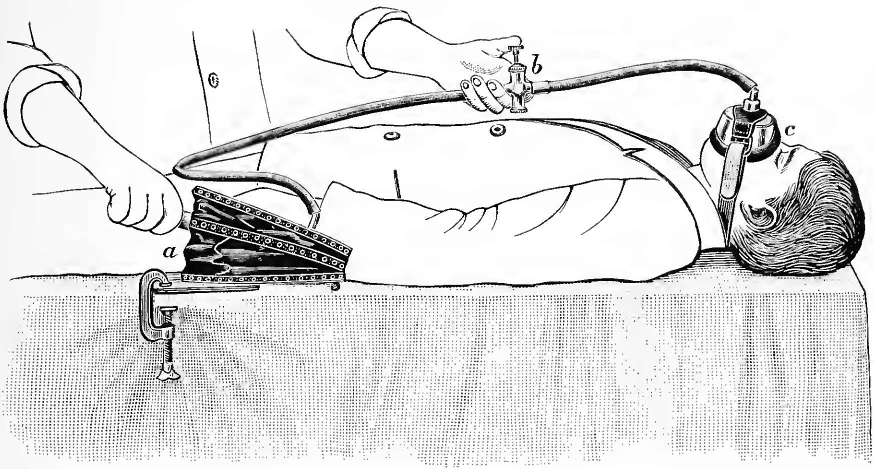


FIG. 276.—FORCED RESPIRATION, *Fell's* IMPROVED APPARATUS. *A*, Bellows; *B*, Air valve; *C*, Face mask. (*Bryant.*)

ing through which the air enters the bellows. A simple arrangement, constructed on the principle of the chemist's wash bottle, by means of which oxygen can be made to pass through a tube into the air valve, thence with the anesthetic into the lungs, can be attached. This device, along with that for mingling oxygen with the inspired air, makes a complete outfit for the purpose. Next to the bellows is the air valve (b) with which it is arranged to act. The operator presses down the piston of the valve a full stroke during three movements of the bellows, thus causing inspiration by permitting the air saturated with the anesthetic to enter the lungs through any one of the selected channels, *i.e.,* the face mask (c), the intubation cone (Fig. 275), or the tracheotomy tube (Fig. 277). The piston is then released until three movements of the bellows are made, which permits expiration to occur. Before the operation is begun the mask should be snugly fitted to the face to prevent any uncertainty in this respect. If, during inspiration, it does not fit so that the cheeks may bulge

FIG. 277.—THE TRACHEOTOMY TUBE AND RINGS USED IN FORCED ARTIFICIAL RESPIRATION, *Fell's* METHOD. (*Bryant.*)

without air escaping by the side of the mask, its action cannot be attained. Frequently a pad or folded handkerchief placed over the bridge of the nose will secure a tight fit. If an intubation tube be employed, a rubber tube from the air valve can be connected with the former and good inflation can be secured, provided that the end of the tube is of proper size to fit the trachea. My best results in long-continued respiration have been secured by means of tracheotomy and the occluding of the trachea with a suitably sized ring screwed to the end of the tracheotomy tube (Fig. 277). But for operative work on the thorax, the other methods appear to be better suited. The size of the bellows and the manner of its operation should be suited to the requirements of individual cases, *i. e.,* one movement for inspiration and one for expiration in a child, two movements for inspiration and three for expiration in a youth, and three for inspiration and the same for expiration in an adult will usually suffice.

Various cabinets have been devised for the purpose, one of which has been extensively used by *Mikulicz.* These apparatuses are cumbersome and difficult to manage. Their employment in well-equipped hospitals is found of use. Under ordinary conditions the *Fell* apparatus will be found to quite meet the indications. It is advised that in all operations contemplating invasion of the pleura and lung and, indeed, the mediastinum, this apparatus be available, and that it be employed in the class of cases alluded to above. With regard to the invasion of the mediastinum, indeed, in sectioning the sternum this apparatus should be available, as the relationship of the pleural cavities to the mediastinum is so atypical as to, in almost all instances, render their puncture exceedingly liable. Quite invariably surgical wounds of the pleural sacs and lungs are treated by the open method. In a few instances, such as decortication of the lung and parietal pleura, and in the rare instances where malignant disease of these parts is attacked, the operation is followed by closure of the wound in the thoracic wall and establishment of drainage. The admonitions with regard to the postoperative care of these cases, as stated above, should be assiduously regarded. The attendant should, for obvious reasons, be prepared to overcome shock. Accidental infection should be carefully guarded against during the postoperative care of the wound, as the pleural sacs are large lymph spaces from which absorption of infective material readily takes place. The infective process calling for surgical interference has, in many instances, already been taken care of by the tissue changes attendant upon the inflammatory process. The surgical trauma is quite likely to open additional avenues for the entrance of infection, and the newly introduced infection may be of a character which the resistance of the patient may not be sufficient to combat.

It is a not uncommon error for practitioners to regard the fact that empyema is an infective process as making asepsis or antisepsis an unnecessary indulgence. The writer warns against action in accord with this belief, on the grounds stated.

THE DEFORMITY

The deformity following resection of the thoracic wall has already been alluded to. Fig. 278 shows a not uncommon ultimate outcome. This may be, to a considerable extent, prevented by gymnastics. The patient should be instructed to take breathing exercises and to undergo exercises with pulleys designed to obviate the spinal curvature. The exercises should not be sufficiently arduous to involve dyspnea, though increase in the number of respirations is beneficial. If the patient be compelled to earn his livelihood while

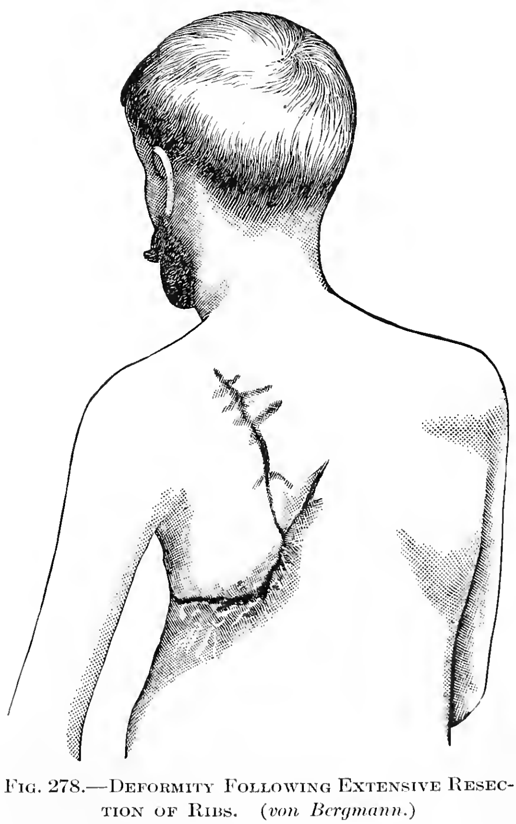


Fig. 278.—Deformity Following Extensive Resection of Ribs. (*von Bergmann.*)

seated at a machine or desk, the chair he occupies should be fitted with a slanting seat, so arranged as to carry the curve of the spine toward the afflicted side. Women should be encouraged to wear corsets which do not take the place of muscular effort. If, for cosmetic reasons, the patient be found intractable in this connection, a few hours a day should be occupied without the presence

Fig. 279.—Retraction of Flap Following Thoracoplasty. (*von Bergmann.*)

of the corest. In all cases the general tone of the patient should be brought to as high a level as is feasible by attention to diet, the administration of tonics, creosote and fat emulsions. The administration of iodin seems to be of benefit. A mixture of syrup of the iodid of iron in an emulsion of the mixed fats has proven of apparent benefit. The causative factor which produced the condition calling for operative relief is, of course, the most determining prognostic element. However, even in tuberculous processes, a favorable ultimate outcome will not infrequently prove sequential to painstaking attention to details in the after-treatment.

Following thoracoplasty by the flap method the cavity left beneath the flap, not having any osseous wall, contracts and bulges with deep respiration or coughing. This has been regarded as the outcome of distention or collapse of the lung (Figs. 279 and 280).

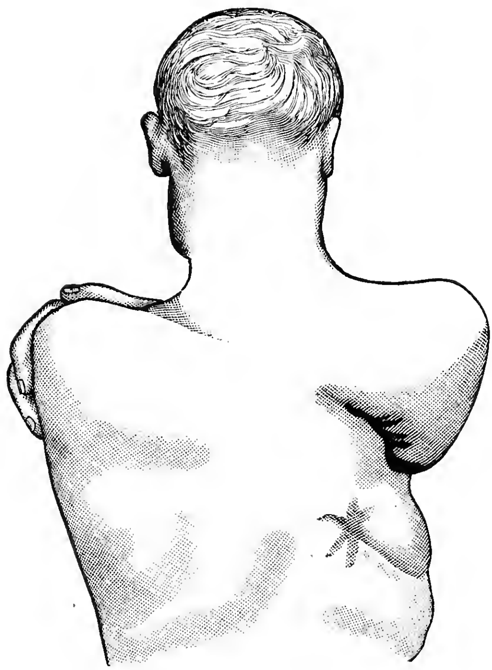


FIG. 280.—BULGING OF FLAP FOLLOWING THORACOPLASTY. (*von Bergmann.*)

The entrance and expulsion of air is, however, not the causative factor in this regard. The bulging may be produced by keeping the glottis open and making pressure upon the abdominal wall in an upward direction.

The phenomenon need not be regarded as rendering exercise of the respiratory function dangerous. During muscular exertion the patient may best be protected from unnecessary strain upon the weakened thoracic wall by wearing a firm pad over the site of the thoracotomy. The retraction of the flap is, perhaps, of minor importance, and it is probable that if any unfavorable outcome is to be apprehended, it is from the bulging. The precaution mentioned has a tendency to obviate these contingencies.

CHAPTER XX

OPERATIONS ON THE SPINAL COLUMN

Laminectomy—Tuberculosis osteomyelitis of the spine.

LAMINECTOMY

Laminectomy, or perhaps more properly stated, resection of the vertebral arches, for the purpose of attacking the spinal canal does not call for especial preparatory measures beyond those given in connection with operations in other situations. Most afflictions of the spinal cord calling for operative intervention are attended with certain trophic changes in the portions of the body located below the seat of disease, and special measures in after-treatment must be carried out to obviate determining complications. The trophic changes spoken of have, too, an influence in the character of the healing process in the wound, and drainage is usually made of wounds in this situation. Immediately after the patient is operated upon, he should be placed on a water bed. It is, of course, quite impossible to obviate absolutely all pressure on the wound, but this should be aimed at, and the patient postured on the side as soon and as long as is possible. For the purpose the attendant must, during the period of semi-consciousness immediately following the operation, be watchful and patient, and not leave the patient until intelligent coöperation may be expected. The patient will, no doubt, be willing enough to carry out instructions designed to obviate pressure upon the wound, but as operations on the spinal cord are usually performed at a time when paralysis exists, he may not be in a position to do so.

A lateral position should not be maintained for more than three hours, and the patient should then be rolled carefully over and so lifted as to avoid trauma to the wound. Each morning the patient should be bathed with tepid water and sponged with alcohol. The occurrence of bed sores is a very likely complication following the operation, and this should be avoided. It is to be borne in mind that alcohol does not act specifically as a preventative of bed sores, and the attendant must not be content with simply sopping the alcohol on the skin. Alcohol simply cleanses and perhaps stimulates nutrition in the skin. The most effective preventative of bed sores is frequent change of posture, assiduous attention to cleanliness, and gentle massage of the skin. The tendency to contractures and posture deformities must be combated by passive motion of all the limbs, especially the lower ones. Immobilization of the limbs with the view of preventing deformity is unwise as ankyloses which are very obstinate are likely to occur. The bladder demands special care. As a rule, afflictions of the spinal cord are attended with paralysis of the bladder. This results in overdistention and overflow, the urine dribbling constantly into the bed. These patients are reported to the attendant as incontinent, and unless investigation is made, the bladder is left filled and the urine undergoes decomposition, causing cystitis. The bladder mucosa becomes severely inflammed and in some instances sloughs from pressure. The result is that fetid urine is discharged, which soaks the bedclothes, and the patient is left lying in the putrid pool at times for hours. Catheterization of the bladder in these cases should be done every six hours following the operation and twice daily after the third day following the operation. Special precautions should be taken to prevent infection of the bladder or urethra during the manipulations, as they must, most likely, be carried on for a long period of time. Infection would make the catheterization a difficult problem.

In some instances, when the bladder is unable to hold any urine whatever, it is best to introduce the "mushroom" retention catheter (Fig. 354). The bladder should not be irrigated unless infection occurs. However, it is not probable that cystitis will be avoided when the retention catheter is employed; so in these instances lavage of the bladder, once daily with a mild solution of potassium permanganate (1 in 1,000), should be practiced. For the purpose no undue force should be employed in injecting the fluid, and no more than six ounces of fluid projected into the bladder at one time, when it is immediately allowed to run out. In these cases no residual cleansing fluid is permitted to remain in the bladder. The mushroom catheter should be removed at the end of twenty-four hours, and the urethra cleansed by the *Janet-Chetwood* method (page 584). Urethritis and its complications may be avoided in this way. Another retention catheter is introduced and the one removed is sterilized and kept submerged in sterile water until it, in turn, is introduced at the next sitting. The distal end of the catheter is connected, by means of a glass tube, with a long rubber tube, which is led into a bottle partially filled with a solution of carbolic acid 1 in 100. The bottle is affixed to the side of the bed.

This measure is far more satisfactory than placing a receptacle between the patient's legs to receive the end of the catheter. These receptacles will be upset and the bed soiled, and, again, the posture of the patient is much more readily varied if the measure suggested is employed. Incontinence of feces is a much more difficult problem than that of urine. The character of the food should be such as not to produce liquid stools, and a daily saline enema should be given. The latter cleanses the lower bowel, and in this way the leakage of feces may be, in a measure, controlled. The administration of cathartics should be avoided, and if constipation alternate with diarrhea, the saline irrigation will be found to serve the purpose in each instance. The anus should be cleansed with tepid water applied with cotton to avoid the irritation produced by the usual materials employed for the purpose.

It will be seen that the execution of the measures here suggested will demand almost continuous attention to the patient. This is true, and, indeed, it is suggested that operative attack upon the spinal cord should not be undertaken unless the conditions can be made to conform to the necessities. Celiotomy and, indeed, many other major operations do not always demand specially skilled after care, though, indeed, this should be obtained when feasible. With operations on the spinal cord, the proposition is constantly and invariably a complicated one, and they should not be undertaken except in well-appointed quarters.

The care of the wound following laminectomy is quite similar to that following operations in other portions of the body. As already stated, the nutritive changes in the soft parts, the outcome of injury to the trophic centers in the cord, renders primary union in the wound quite unlikely. In any event, free drainage should be established. If the subdural space has been invaded, free discharge of cerebrospinal fluid occurs, and this must not be permitted to soil the dressing for any considerable period of time. In this event the dressing should be changed twice daily or more frequently if necessary, the number of changes of dressing in the day being regulated by the amount of discharge of fluid. As stated in connection with the discharge of cerebrospinal fluid following invasion of the brain and its membranes, it is best to protect the wound with an antiseptic protector. For the purpose the layer of gauze remote from the wound may be of the kind impregnated with corrosive sublimate, iodoform, vioform, etc. The layer of gauze nearest the wound should not be medicated for fear that dermatitis may occur as the result. The skin in this situation is, indeed, most likely to develop inflammation for the reasons stated above.

Textile fabric drainage in the form of the "cigarette drain" (Fig. 154) is perhaps the most useful agent for the purpose, though silk-worm gut (Fig. 147) may suffice in some instances. The wound is best held in apposition by silk-worm gut sutures, for the reasons already frequently discussed in this work.

Laminectomy for fracture of the vertebræ contemplates removal of the offending fragments of bone. Necrosis of bone does not frequently follow the operation, as the vertebræ are amply supplied with blood. However, it does occur, and the complication must be borne in mind with the view of determining the time when the drainage agent may be permanently removed. The necrosis is likely to be only superficial, but will, nevertheless, give rise to a rather brisk reactionary inflammation if opportunity for free egress be not made. In this class of cases it is, therefore, best to maintain drainage for two weeks following the operation, and the sutures may be left *in situ* for the same period of time. The textile fabric drain, if employed, may be removed on the fifth day following the operation, and for the remaining portion of the two weeks mentioned silk-worm gut drainage may be used. If at the end of this period of time there be no evidence of dead bone, the drain may be removed. If, however, the discharge from the drainage wound take on the characteristic "prune-juice" character, indicative of dead bone, the drainage must be maintained until the discharge takes on the characteristics of clear serum, when the drain may be removed.

TUBERCULOUS OSTEOMYELITIS OF THE SPINE

Tuberculous osteomyelitis of the spine is subjected to surgical attack when so-called cold abscess forms, or when a purulent infection is superadded to the tuberculous process. The operation consists usually of simple drainage of the abscess cavity, though in some instances free incision and packing of the wound is employed. It is, perhaps, permissible to stretch the scope of this book sufficiently to state that the latter method of relief is the wiser. Simple incision and drainage, the valvular approach, and similar measures of relief are all procrastination. No pathological process is benefited by anything so much as by its radical removal. If this be feasible it should always be done.

Cold abscess usually points at the space of *Petit,* though almost any portion of the back may be the site of its local manifestation in a certain small percentage of cases. After the abscess has been freely incised and its walls curetted, the cavity is packed with iodoform gauze in the manner shown in Fig. 223. This packing is left *in situ* for forty-eight hours, when it is removed in the manner already described in connection with the treatment of infected wounds.

It must be remembered that tuberculous osteomyelitis of the spine has its primary focus almost invariably in the body of the vertebræ, and that an attempt to obtain communication with the seat of the bone infection should be made. For the purpose a strip of the gauze packing should be carried well down toward the body of the vertebræ, with the view of supplying an avenue of escape for the necrosed bone and inflammatory discharges. After the wound takes on a healthy appearance, the spine should be immobilized in a plaster-of-Paris jacket and a window cut in it corresponding to the site and area of the wound. As the discharge from the wound is liable to find its way between the skin and the plaster cast, the wound must be dressed every day and the edges of the plaster cast contiguous to the wound protected with oil silk.

As soon as the spine is immobilized, the patient is permitted to go about or at least is wheeled into the open air in a chair. No attempt should, however, be made to send the patient to remote health resorts unless he be attended by some one skilled in the care of the wound. An added infection, suppurative in character, is exceedingly undesirable at this time, for obvious reasons. The usual dietary treatment used in tuberculosis must be employed, and this begun as soon after the operation as is feasible. Prompt immobilization of the spine, as indicated, will tend to obviate the distressing deformity which is so largely the sequel of this affliction.

As tuberculosis of bone is quite constantly an expression of tuberculosis elsewhere, an attempt should be made to locate the port of entrance of the infection, and this should be subjected to appropriate treatment.

Above all cases of this sort must not be confined to bed any longer than is absolutely necessary Immobilization of the spine is quite feasible very soon after the operation, the window used for the local treatment of the wound being in no wise an interference in this connection.

If it be necessary to cut away considerable areas of the jacket with the view of obtaining the necessary amount of room for proper care of the wound, the jacket may be reinforced at its lateral sides by burying strips of galvanized steel in the layers of the plaster-of-Paris bandages.

CHAPTER XXI

OPERATIONS ON THE ABDOMEN

Celiotomy—Special preparation of the gastrointestinal canal — Sterile diet—Drainage—Closure of abdominal wound—Drainage of superficial wound—The protective dressing—After-treatment following celiotomy.

CELIOTOMY

Celiotomy is at the present time so frequently performed that a few additional remarks with regard to the special preparation of patients about to be subjected to surgical invasion of the peritoneal sac seem justified. It is true that recent investigations tend to prove that the peritoneum is not as vulnerable with respect to infection as was formerly believed, and this is ascribed to the fact that this membrane represents a lymph space and consequently is regarded, in the light of the function of the lymphatic system, as capable of causing certain modification in the constituents of pyogenic material which renders toxic effects less liable so far as the blood is concerned. It must be remembered, however, that a too great complacency in this connection is a dangerous viewpoint to take regarding the problem, and one which is to be deprecated.

It is, indeed, true that purulent collections which have been in contact with restricted areas of the peritoneum for a considerable period of time will not, upon liberation and contact with contiguous portions of the peritoneum, give rise to additional infection. Yet there is no means of ascertaining at the time of the operation whether the infectiousness of the process has been exhausted or whether sufficient virulence is still present which, when the new field of invasion presents, may develop a seriously menacing inflammation. Clinically it not seldom happens that the invasion of the female pelvis for relief of pyosalpinx of long standing, which involves soiling of the peritoneum with pus, is followed by an acute septic peritonitis and death under conditions which makes infection from without during the operative procedure exceedingly improbable, and must be ascribed to that contamination from the suppurative process which had been locally confined and mechanically walled off by adhesive peritonitis when brought in contact with heretofore uninfected areas.

The accidental introduction of infection, while objectionable in all portions of the body, is not as frequently followed by severe symptoms, death, and serious sequels as obtains in the peritoneal sac. The rules laid down above should be carefully followed with the view of avoiding these contingencies. Celiotomy made with the view of invading the lumen of the gastrointestinal tract calls for additional preparation, which will be presently taken up. In this connection it is proper to state that invasion of the lumen of the gut means contamination of the operative field to a greater or lesser degree in all instances. A slight amount of infective invasion will be taken care of by the natural resistance of the peritoneum. The technic of asepsis should, therefore, be directed toward limiting the infective possibilities to the unavoidable amount, and for this reason each step of the preparation for operation should be subjected to painstaking directorate to this end. The situation may be illustrated by the fact that an appendectomy, which involves but a meager solution of continuity of the gut, is more liable to be followed by infection than a hysterectomy for a large fibroid tumor. Clinical experience will be found to bear out this statement. Practitioners who remove tumors from the abdomen in country practice and contend that infection does not complicate their cases should bear in mind that their results are not so favorable in cases when the gut is opened. The contention that asepsis need not be so assiduously employed in the country, on the ground that septic bacteria do not exist largely in less closely populated districts, can, of course, not include in this belief the *Communis coli,* which is the normal resident of the gastrointestinal canal even in the arctic regions, where sterility as regards infective bacteria is quite commonly found to exist.

In a general way, it may be said that celiotomy should not be made without forty-eight hours' preparation of the patient, if this be consistent with the indications. Invasion of the gastrointestinal canal should be preceded by preparation extending over four days if the conditions warrant this delay. Observance of these admonitions will be found to conserve most the best interests of the patient as regards immediate and ultimate outcome of surgical intervention in this situation.

The primary incision, which sections the skin and muscle together with their fascial inclosures, should be made with instruments which are then discarded and replaced by fresh ones. For this purpose the knife and scissors should be duplicated. Ample provision should be made for gauze packing, and a large number of abdominal pads (Fig. 23, page 70) should be provided. These—the pads—should be counted and their number recorded for comparison before the abdominal wound is closed, to prevent the accidental retention of a pad in the abdomen, an occurrence which, unfortunately, is not uncommon. The same rule should be applied to instruments, especially artery forceps, all of which should be accounted for before the peritoneal sac is sutured, in accord with the original tabulation recorded before the operation. A copious saline lavage should be provided for, and the paraphernalia necessary to its employment be at hand (page 114, *et seq.*).

The local preparation of the patient should receive especial attention, and when the patient is postured on the operating table, the body should be placed in such relationship to the mechanism of the table as to permit of change of posture, such as the *Trendelenburg* position, without disturbance of the sterile surroundings contiguous to the operative field, a contingency which is liable to cause exasperating delay in the operative procedure. As operations involving the abdominal cavity are frequently attended with shock of more or less intensity, ample provision should be made to meet its occurrence (page 227).

SPECIAL PREPARATION OF THE GASTROINTESTINAL CANAL

The special preparation of the gastrointestinal canal together with the mouth and pharynx contemplates achieving comparative sterility of the canal. The treatment of the mouth and pharynx has already been stated (page 362), and need not be repeated here. The portion of the text devoted to the question of diet and cleansing of the gastrointestinal canal, and the discussion of its rationale, is taken from *Moynihan,* whose masterly summary of the situation may be regarded as standard in accordance with the present condition of the sciences.

Sterility of the digestive tract in its entirety is probably not attainable. The aim is to reduce the number of bacteria in it. The newborn enters the world with a sterile digestive tract, a fact *Billroth* first called attention to. Contamination with bacteria occurs a few hours after birth. *Moynihan* regards the question of the bacteriology of the alimentary tract as sorely in need of elucidation. He states:

The exact origin of the *Bacillus coli,* which is the constant inhabitant of the intestinal canal in man, has never been satisfactorily determined, but there can be little doubt that the infection takes place through the mouth, and that the vehicle is the food. It is to *Escherich* that we owe a recognition of the fact that the *Bacillus coli* is the characteristic organism of the human intestine, and that it remains an unvarying inhabitant throughout life.

A bacterial invasion of the intestinal canal is not essential to the life or health of the individual. Experimental work, which has been amply confirmed, has shown that life may be sustained in young animals whose food and whose surroundings are sterile. *Nuttall* and *Thierfelder* obtained a guinea pig from its mother by Cesarean section, and placed it at once in a sterile chamber, supplied with sterile air, and fed it upon sterilized foods. At the end of eight days the animal, which was thriving, was killed and its intestinal contents found to be sterile. *Levin* investigated the bacterial conditions in the intestinal canals of animals, bears, seals, etc., in Spitzbergen, and found that, as a rule, the contents of the bowel was sterile. In the arctic regions, of course, there is a great scarcity of organisms both in the air and in water.

Within the first few hours of life the intestinal contents cease to be sterile; organisms can always be found. Of these organisms two varieties are described—the permanent and the transient. The permanent variety in man is the *Bacillus coli,* the transient includes any that are introduced into the intestinal canal by the food. It is obvious, if any organism whatever be introduced deliberately into the stomach with the food, it will remain for a shorter or longer time an inhabitant of the alimentary canal. But, as *Gillespie* and *Miller* have shown, when the bacteria are introduced in this way, there is a steady decrease in their numbers as digestion proceeds and in proportion to the increase in the acidity of the gastric contents. According to *Miller*, at the end of nine hours the stomach contains no organisms. In the duodenum the number of organisms is small; but, the further down in the intestine is the material from which the examination is made, the more numerous are the organisms, until the ileocecal valve is reached. In the large intestine the bacteria are again few in number. *Gilbert* and

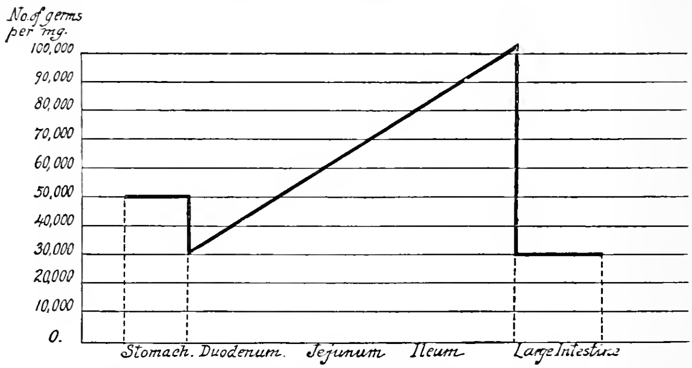


FIG. 281.—*Gilbert* and *Domenici's* DIAGRAM SHOWING THE RELATIVE NUMBER OF BACTERIA PRESENT IN THE CONTENTS OF DIFFERENT PARTS OF THE ALIMENTARY TRACT. The dogs were killed three hours after a meal of bread and meat. Examination of the intestinal contents at this stage of digestion showed an abundance of organisms in the stomach, a pronounced diminution in number at the duodenum, followed by a gradual rise to the ileocecal valve, where bacteria flourish in the greatest luxuriance. When the large intestine is reached there is a marked falling off in number, with a slight rise proportionate to the distance from the cecum. (*Harvey Cushing.*) From *Moynihan.*

Domenici have presented diagrammatically the average bacterial virulence of the alimentary canal of dogs. (Fig. 281.)

Harvey Cushing has investigated the conditions in cases of intestinal fistula. In a case of jejunal fistula a glass of milk could be entirely recovered within a few minutes of its ingestion, with its bacteriological features practically unchanged. The importance of the physical characters of the food is, therefore, considerable. If the ingesta be fluid they are passed rapidly onward into the duodenum and are but little, if at all, altered by transit through the stomach. If the food be solid, it will remain, perhaps for hours, in the stomach, subject throughout this time to the action of the gastric juice, and when passed into the duodenum it will have the number of bacteria greatly reduced. *Macfadyen*, quoted by *Cushing*, has shown that the bacillus of anthrax, an organism easily killed by the gastric juice, cannot be recovered by the intestine when taken after a full meal, but when administered with a large amount of liquid on an empty stomach, its recovery from the lower bowel is easy. In one of *Cushing's* cases, the *Bacillus prodigiosus*, an organism especially susceptible to the action of gastric juice, could be easily recovered from a jejunal fistula after its ingestion with inoculated milk.

When the stomach has emptied itself of food, either fluid or solid, the mucous membrane is sterile; the small amount of material that can be scraped from the mucous surface contains no organisms. *Marfan* and *Bernard* have shown that the same applied to the intestine; that when any part of the intestine has emptied itself of its contents, it becomes amicrobic. In cases of artificial anus in man, the distal loop of the bowel, so long as it remains empty, is always found to be sterile. If from any reason the stomach is unable to empty itself satisfactorily, leaving always some food stagnant, the natural amicrobism can never be attained. *Cushing* writes: "It is, I believe, dependent only upon interference with the stomach's power completely to expel its contents that the bacterial life may persist in its lumen. The same principle holds true for the duodenum, and it is not improbable that a similar amicrobic state following digestion, with a canal completely free from food and the accompanying bacteria, may be brought about as far down as a condition of emptiness may be reached through fasting." In a dog that had been starved for several days, the upper part of the intestine was found sterile. The accompanying diagram

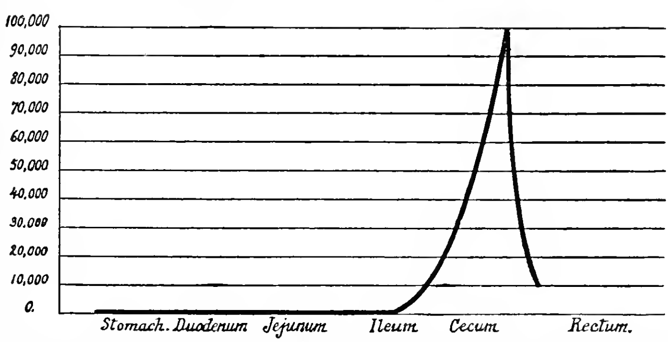


FIG. 282.—*Harvey Cushing's* DIAGRAM SHOWING THE RELATIVE NUMBER OF MICRO-ORGANISMS AT DIFFERENT LEVELS OF A DOG'S INTESTINE AFTER PROLONGED FAST. (*Moynihan.*)

(Fig. 282) which *Cushing* gives may be contrasted with that of *Gilbert* (Fig. 281). It will be seen that all that portion of the intestine which can be rendered empty is by this means alone rendered sterile, also. Conversely, in cases of acute or chronic intestinal obstruction where the bowel has been unable to empty itself for days or for weeks, the intestinal contents are teeming with bacterial life. The *Bacillus coli* and streptococci are found in great numbers, and their virulence is extreme.

The conclusions which may be stated are as follows:

1. The stomach contains, immediately after a meal, a number of microörganisms of different varieties, according to the nature of the food administered.

2. If the food is given in liquid form, it is rapidly passed onward into the intestine, and the bacterial forms are but slightly, if at all, affected.

3. If food is given in solid form, it remains longer in the stomach, and the number of bacteria contained therein undergoes a steady diminution until digestion is complete. The empty stomach is then amicrobic.

4. The duodenum is often sterile; the number and virulence of bacteria of the intestine increase in proportion to the distance from the duodenum, and attain their maximum at the ileocecal valve.

5. The *Bacillus coli communis* is the characteristic organism of the human intestine; it is never absent after the first few days of life.

6. The stomach and the upper part of the jejunum can be rendered sterile by administering only sterilized foods and by attention to the toilet of the mouth. In dogs, starvation for a few days leaves the upper part of the intestine empty and sterile.

7. The stomach and intestine, when their contents have been discharged and they are empty, are sterile. If the emptying is prevented by obstruction at the pylorus, or in the intestine, the contents, dammed up behind the block, contain organisms whose number and whose virulence are greatly increased.

The importance of these facts from the surgical point of view is that they show what is to be expected in cases of perforation of the stomach or intestine, and they demonstrate the possibility of rendering sterile, for purposes of operation, the stomach and upper part of the intestinal canal. For example, when peritonitis results from a perforation high up in the intestine, the offending microörganism is generally a streptococcus; when the perforation is low down in the intestine, the *Bacillus coli* is the most abundant or the only organism.

It is to *Dr. Harvey Cushing,* of Baltimore, that we are indebted for calling the attention of surgeons to the possibility of rendering the stomach and intestine sterile as a preparatory measure to operations. He wrote, in a very able paper from which I have freely quoted (vol. IX, *Johns Hopkins Hospital Reports*):

The procedure which we have employed is simple and mainly consists in an attempt to render amicrobic all ingesta. The mouth is rinsed with an antiseptic solution and the teeth are carefully brushed at intervals of a few hours, and with especial care before and after feeding. The stomach, if any chronic catarrh exists and microörganisms in number are found present after a test meal, is washed out carefully morning and evening. Food is taken in small amounts and at comparatively frequent intervals, from clean or, preferably, sterile vessels, and consists of boiled water, sterilized milk, beef tea, albumin water, and similar liquids. Patients with chronic gastritis have been seen to gain weight under this regime. Preliminary to the operation for from six to ten hours nothing is given by mouth, rectal feeding being instituted if necessary.

Many drugs have been given in the hope that by their aid the intestinal contents could be rendered sterile. Among such are β-naphthol, salol, iodoform, and actol, to mention only a few. All have proven useless. Recently *Adolph Hoffmann* (Mittheilungen a. d. Grenzgebiet. 1906. Bd. 15 Heft 5. P. 596) has recorded a series of observations made upon the intestinal contents recovered from fistulæ, colotomy openings, and enterostomy openings after the administration of isoform. This drug is administered in powder or in capsules, or in both together, the dose being 3 grammes, given in quantities of ½ gramme, within a period of two to twenty-four hours. The effect was remarkable and constant. The number of colonies that could be cultivated from the discharge was enormously reduced in all cases. The rapidity with which the effect upon the contents was produced depended upon the part of the alimentary canal from which cultures were taken. In cases of pyloric disease the effect upon the stomach contents was noticed in a few minutes if the drug was administered in powder. Isoform is supplied in powder and in capsules, hardened and unhardened—the latter dissolve in about an hour and a half in the stomach, setting free the drug; the former pass into the intestine, where they are dissolved in a variable and often uncertain time. In the intestine an undoubted effect is produced in thirty hours from the administration of the dose. Though 3 grammes is the usual dose, as much as 7 to 8 grammes have been given to the adult male without producing distress. The symptoms which come from an excessive dose, or from too frequently repeated doses, are loss of appetite, vomiting, and a feeling of sickness.

Acetozone dissolved in sterile water is a useful agent in this connection. About seven and a half grains are added to a half pint of hot water, and to this a half pint of cold sterile water is added. The patient sips this in place of pure water as a beverage between feedings. The greatest field of usefulness of the agent is as a preparatory measure in operations on the stomach. The writer uses it preliminary to gastroenterostomy.

STERILE DIET

The administration of sterile diet in hospital practice is not attended with special hardship, as, of course, the means of sterilization of the articles of diet and the containers is an easy matter. In private practice the problem presents some practical difficul-

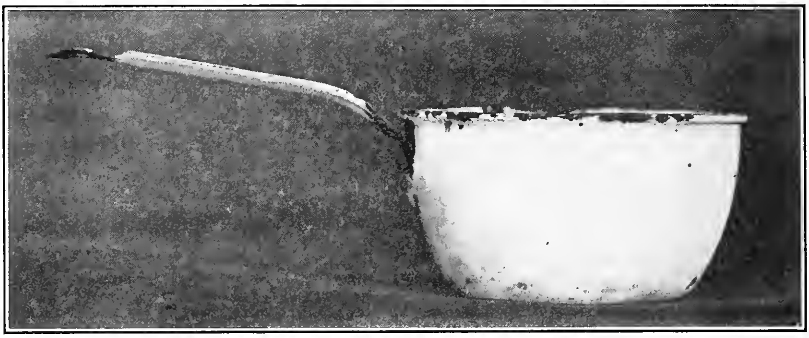


FIG. 283.—VESSEL FOR ADMINISTRATION OF STERILE FLUIDS.

ties. Of course, chemical sterilization of the vessels used in prehension is impossible, because the antiseptics are not proper articles of food. Sterilization of the vessels mentioned must be attained by heat. For the purpose white enameled receptacles may be used, which are boiled. A gas stove with two burners should be placed in the patient's immediate environment, one of which furnishes heat to the large metal boiler in which the receptacles are sterilized by boiling for twenty minutes, and the other cooks the food. Dry baking will, of course, not sterilize the food, and as liquid food is to be partaken of for the four days preceding the operation, this outfit will be found to serve the purpose.

Contamination of the vessels is liable when being used for transporting the nourishment from the boiling utensil to the patient's mouth. To avoid this, small vessels with handles should be used, and at no time need the hand come in contact with the portion of the vessel which must not be contaminated. Fig. 283

shows a vessel which has been found of use in this connection, which will be found in most households or is, at least, obtainable in housefurnishing stores. Several of these vessels may be at hand at a time.

After the sterilization by boiling is completed, the handle of the vessel is grasped with a sponge holder and so manipulated as to be accessible to the hand of the attendant. This had best be done after the water has sufficiently cooled to make manual contact possible. It is unwise to expect the attendant to sterilize the hands each time a feeding takes place. Again, if the patient himself is enabled to handle the vessel from which the food is taken, the rate of administration of the food is under his own control, which is desirable. The food should be cooked and, of course, at the same time sterilized in a vessel which will permit of the liquid being poured into the feeding vessel without contamination. Vessels which have handles are exceedingly convenient for

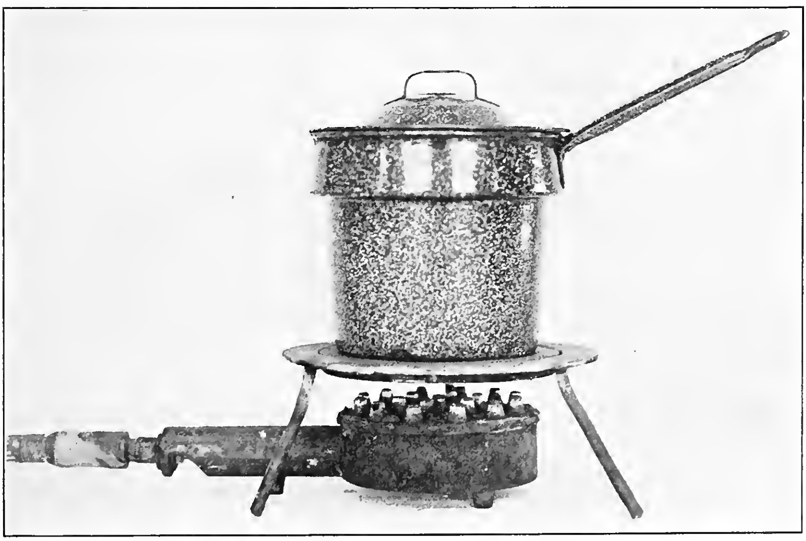


Fig. 284.—Arrangement for Sterilizing Food.

the purpose (Fig. 284). It should be borne in mind that albumin is coagulated by heat, and that the nutritive constituents of the basis of broths is not present in liquid extracts. There is no objection to the administration of particles of macerated beef which has been subjected to sterilizing heat, for the reason stated, and, too, because the presence in the stomach of firmly coagulated albuminoids stimulates secretion of gastric juice, as has been experimentally proven in many instances. If, as *Cushing* says, a normal secretion of gastric juice contributes much to the sterility of the gastrointestinal canal, the use of this preparation is advisable. The method of preparation consists of macerating fresh, lean beef in a mangler, mixing it with cold water, and, after adding seasoning, boiling for twenty minutes. The result is a mushy mess which is readily swallowed without mastication and is quite palatable. Indeed, the mess can be forced through the stomach tube immediately after gastric lavage by a syringe (Fig. 251) when, for any reason, the latter is systematically employed as a preliminary step to operation. The administration of the mixture may be done once daily as supplementary to the pure liquid diet. Milk is, of course, readily sterilized by boiling, but the coating of the fat globules with the coagulated albumin renders it of less service as a food, more especially as the digestion of fats takes place in the small intestines. However, this should not act as a deterrent to its judicious use. For the purpose, milk with a portion of the cream removed had best be used for the day before the operation. The additional hardship to the digestive tract several days before the operation may be regarded as counterbalancing the objection stated. Carbohydrates in the form of grain gruels may be sterilized and given to within twenty-four hours before the operation. The fact that carbohydrates leave considerable residue in the intestinal canal after extraction of the nutritive constituent by the circulation explains the rationale of this advice.

The use of table service, spoons, etc., had best be dispensed with, and the patient is ordered to partake of nourishment directly from the vessel into which the food has been poured. Boiling of the food in the same vessel from which it is administered is not desirable, as its upper, outer portion is subjected only to dry heat, and is not as certainly sterilized as when boiled in the manner stated. Water is, of course, readily made sterile, and may be administered in the same way as sterile food. It will be found, however, that but little water will be partaken of during the administration of liquid food. Indeed, the aim of the latter may be to obviate the necessity of its use.

DRAINAGE

Drainage after abdominal operations has been so extensively discussed in the recent literature that protracted treatment of the subject in this connection is quite out of place.

Yates, quoted by *Moynihan,* says "drainage of the general peritoneal cavity is physically and physiologically impossible." This is no doubt true. It is to be remembered, however, that this does not dismiss the subject of drainage after abdominal operations, as the terse statement above might lead one to believe. There are many instances in which the abdomen is opened in which drainage is distinctly indicated, but these instances are limited to the class of cases when egress is made possible by furnishing an avenue of escape of inflammatory exudates which are situated immediately contiguous to the wound of entrance, *i.e.,* to the drainage opening. For instance, a large peritoneal abscess complicating pyosalpinx has for its walls a thickened pyogenic membrane which it is impossible to remove at the time of the operation. Drainage under these circumstances is essential to recovery, despite the fact that the pyosalpinx itself may have been removed at the time of the operation. A pericecal abscess complicating suppurative appendicitis, with sloughing of the cecum contiguous to the inflamed appendix, will almost surely be followed by a fecal fistula. Here, certainly, is an indication for drainage, but here, again, the problem is not that of drainage of the general peritoneal cavity. The statement of *Yates* is not damaged in the least by the equal truth of the examples offered, yet a casual perusal of it might lead to an erroneous conclusion. The special indications for drainage in a given class of cases will be taken up under their especial heads. *Yates* also states "peritoneal drainage must be local, and unless there is something to be gained by rendering an area extraperitoneal, or by making such an area a safe path of least resistance leading outside the body, there is, aside from hemastasis no justification for its use," which is another way of saying what has been offered above. Yet, this later statement is at the first glance so at variance with the one first quoted as to perhaps lead to confusion, which an attempt has been made here to efface.

The question of drainage is, of course, determined at the time of the operation. Its removal is frequently a question which the general practitioner has to determine as to how soon the drain may be removed. Nor, indeed, is this question always easy to decide. Hernia follows celiotomy most frequently when drainage has been employed, yet it is wiser to run the risk of this complication than to permit of the reaccumulation of septic secretions, the result of too early removal of the drainage agent. The question is also taken up in connection with a given class of cases in this regard. However, it may be proper to state here that, as far as the danger of invasion of the contiguous peritoneum is concerned, this is obviated in twenty-four hours following the operation. The wound of egress, through the abdominal wall, need not be artificially kept open for more than four days, at which time the septic secretion will be found to have made an avenue of escape for itself along the path of the drain, and the secretion needs thereafter be simply guided toward the periphery by strands of silkworm gut, which are gradually reduced in number until the discharge ceases. Postural efforts at drainage are indicated in the class of cases mentioned, though they are of doubtful value when general peritonitis exists, *i.e.*, a local collection of pus will drain better if the patient be postured in such a manner as to make the seat of affliction the most dependent portion of the body. A hard and fast rule in this regard is objectionable, as, for instance, in cases where the suppurative process is low down in the pelvis and abdominal drainage is made, the sitting posture is contraindicated for obvious reasons. The drainage material employed in this situation is governed by the same rules as obtain in other portions of the body (page 186).

It is the writer's practice to employ drainage in accord with the statements made above. A perhaps common source of error with respect to the efficiency of drainage and its bearing on the outcome with respect to recovery, is the fact that no doubt the prognosis of general, or at least widely spread, septic peritonitis depends largely upon the character of the causative infection. An observer may be led to regard the measure as effective in a series of cases of this sort, in which the infection did not possess great virulence, and the reverse may be the case if a series of cases of great virulence come under observation during a short period of time.

CLOSURE OF THE ABDOMINAL WOUND

Closure of the abdominal wound is universally made by "tier suture." The suture material employed for apposition of the deep layers of the abdominal wall should consist of absorbable suture material. The suggestion with regard to the use of thick catgut in deep wounds, taken up under the general head of suture material (page 85), should be borne in mind. Deep infection in this situation, though comparatively rare, does at times occur, and if the wound need be opened with the view of draining the pus, ventral hernia is likely to occur. For the purpose of closing the peritoneum, No. 1 plain catgut; for the muscle, No. 2 chromicized gut; for the rectus sheath, No. 1 plain gut are the sizes advised. The skin is best closed with iron-dyed silk-worm gut, the reasons for which have already been stated (page 97). The rationale of using plain catgut of small diameter in the rectus sheath, is that this membrane is but sparsely supplied with blood and consequently does not readily absorb the suture material. The presence of chromicized gut for a prolonged period of time favors infection and, indeed, it not infrequently happens that on the tenth day or later, following the operation, separation of a slough of the sheath necessitates opening of the wound. The attendant is warned that the employment of a continuous suture in the rectus sheath which is tightly drawn and comprehends frequent puncture of its substance is a menace in this connection from strangulation of the edges of the sheath of the muscle. The rectus sheath should be closed with sutures which are placed only sufficiently closely together to hold gently the edges of the wound in apposition. In no portion of the body is the fallacious notion that firm apposition of wound surfaces is essential to healing more objectionable than in closure of an abdominal wound. Union by primary intention is exceedingly desirable in this situation. Aside from the dangers involved as regards postoperative hernia, as stated, the patient, who would probably have been able to leave the bed in two weeks or less following abdominal section, is confined to bed for several additional weeks while the healing by granulation takes place.

DRAINAGE OF THE SUPERFICIAL WOUND

Drainage of the superficial wound after celiotomy has been quite discarded, unless, of course, in the event of the presence of the conditions in which drainage is introduced into the abdominal cavity, when the drain entering the peritoneum also answers the purpose for the superficial wound. Most surgeons entirely close the superficial wound in clean cases. It is, however, rational to make somewhat elastic this proposition. Given a fat abdomen sectioned and the edges of the wound subjected to prolonged trauma, the outcome of hauling and mauling with retractors, or the operator's hands, superficial necrosis of the subcutaneous fat is very likely to occur and, as nature attempts to throw the foreign material off, a purulent secretion accumulates beneath the skin, which it becomes necessary to liberate by opening a more or less extensive portion of the skin wound. Again, a fat abdominal wound will ooze a peculiar oily material from the subcutaneous tissues, which undergoes much the same alteration stated above. This secretion is not arrested by the usual hemostatic measures; indeed, efforts made in this direction involve a degree of trauma to the tissues which, of itself, favors necrosis. In these cases a small drain, placed contiguous to the rectus sheath and immediately beneath the layer of subcutaneous fat and brought out at the inferior angle of the wound, will permit of egress of the offending material and favor primary union. The skin plays no part in retention of the abdominal contents, and the slight delay in union caused by the presence of the drain need not be regarded as a disturbing factor of determining import. The drain may consist of strands of chromic catgut or silk-worm gut, and is removed on the third day following the operation. At this time the gauze contiguous to the wound will be found quite saturated with a glairy secretion, slightly stained with blood which has been given an opportunity to escape from the wound by employment of the superficial drainage.

THE PROTECTIVE DRESSING

The protective dressing consists of two layers of folded gauze (Fig. 187), which is applied immediately contiguous to the wound, as shown in Fig. 187. This is supplemented by fluffed gauze (Fig. 188), the latter being applied in large quantity if drainage has been introduced into the peritoneum. The fluffed gauze is covered with "combined dressing" (Fig. 190), and the entire dressing held in place with strips of adhesive plaster. For the purpose the strips are, in some instances, carried across the dressing in one piece and extend to well on the flanks.

This has the advantage of making firm, equable pressure upon

Fig. 285.—Abdominal Dressing Held in Place With Adhesive Strips and Tapes, Allowing of Change of Gauze Pad Without Removal of Adhesive Plaster.

the abdomen, which is desirable for the first twelve hours following the operation. However, at the end of this time distention of the gut almost invariably occurs, and the pressure becomes exceedingly distressing to the patient. The strips may then be loosened, a step which calls for considerable disturbance. In most instances it is the wisest to fasten the adhesive plaster strips to either flank and unite them by means of tapes over the dressing (Fig. 285). It will be seen that it requires only untying of the tapes to effect the purpose. Whatever pressure need be made upon the abdomen can readily be attained by means of the

FIG. 286.—MANY TAILED ABDOMINAL BINDER *in situ*.

Scultetus (Fig. 286) binder, and this can be loosened with a minimum of disturbance to the patient when the indication arises.

In the absence of the *Scultetus* bandage, a binder similar to that used after confinement may be used (Fig. 287), which will serve quite well the purpose. Two perineal straps should be used, as this bandage is more likely to slip upward as the result of the patient's movements.

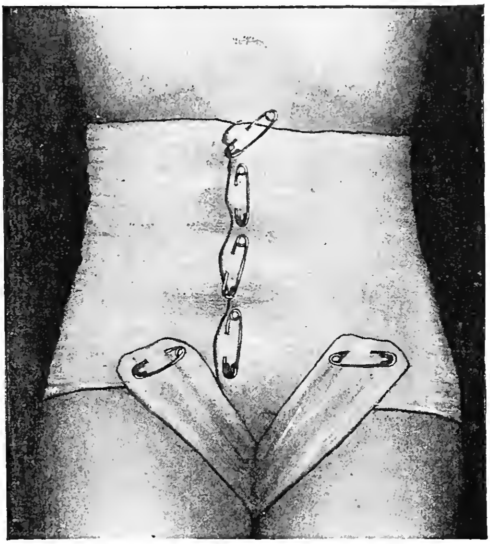


Fig. 287.—Retaining Bandage after Celiotomy. (*Bryant.*)

THE AFTER-TREATMENT FOLLOWING CELIOTOMY

The after-treatment following celiotomy involves no particular modification with regard to shock and narcosis precautions (page 154). As soon as these two elements have been eliminated, the posture of the patient depends upon the affliction for which the section has been made. After operations upon the stomach and following some on the gall-bladder, the sitting posture will be found to best conserve the patient's comfort and the intent of the operative procedure.

Postoperative vomiting has been made the text of extensive discussion above (page 272, *et seq.*). Following celiotomy this symptom takes on additional import, and attention is called to the necessity of avoiding its occurrence, or at least contributing to its arrest as soon as possible. Some surgeons wash out the patient's stomach while he is still on the operating table and before narcosis is recovered from. The measure has no objections discernible to the writer and, indeed, may obviate distressing symptoms. Whatever conception may be had of the measure regarding its routine employment after operations in general, it is a desirable indulgence following celiotomy performed for conditions which of themselves are accompanied by vomiting. In the presence of peritonitis or intestinal obstruction, the measure should always be employed. The fact that the patient is still narcotized eliminates, as far as this particular lavage is concerned, the distressing retching and vomiting attendant upon gastric lavage made during consciousness. With the patient still narcotized, copious, prolonged, and thorough lavage of the stomach may be made without bringing any strain upon the wound, which latter is so objectionable when the measure is employed during the post-operative period following celiotomy. At the end of the lavage no residual cleansing fluid should be permitted to remain in the stomach, for fear of contributing to the dilatation of this organ, which may occur as a postoperative complication. Acute dilata-

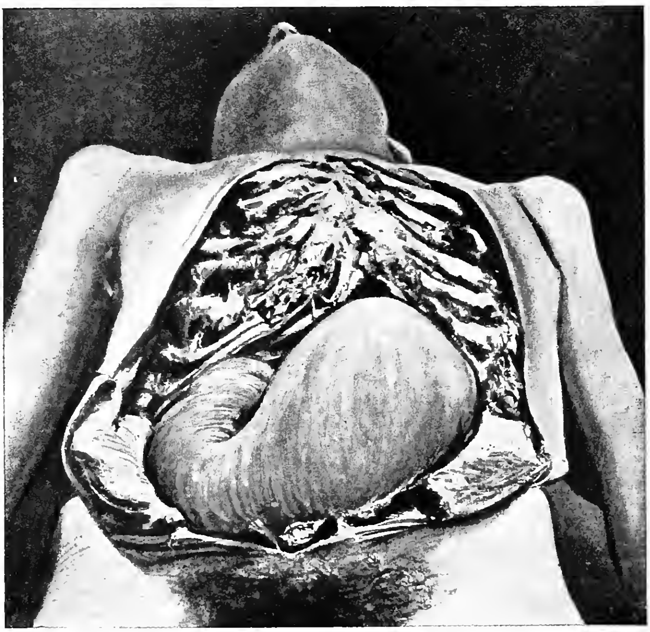


Fig. 288.—Acute Dilatation of the Stomach Following Abdominal Section. (*Campbell Thomson.*)

tion of the stomach sequential to celiotomy is a more frequent occurrence than obtains after operations involving other portions of the body. The problem has been quite extensively taken up above (page 277, *et seq.*). Allusion is made to it in this connection for the reason stated with regard to frequency. Fig. 288 shows a specimen of dilated stomach. The illustration is placed contiguous to this portion of the discussion to emphasize the subject.

It is not improbable that routine lavage of the stomach following celiotomy, especially if the gastro-intestinal tract has been invaded, is of service in preventing acute dilatation of this organ.

After the patient is returned to bed and postured, as stated above, in the way to meet the indications, he is not disturbed until narcosis is recovered from. Patients who have been subjected to extensive operations or those which have involved loss of large quantities of blood, are likely to be very restless. Of course, the shock treatment is then instituted at once, which implies close attendance. However, if restlessness follows from irritation of nerve centers due to the previous alcoholic habits of the patient, or as the outcome of the subconsciousness between narcosis and mental clearness, it may be necessary to restrain the patient with the view of avoiding damage to the wound, displacement of the protective dressing, or, indeed, to prevent the patient from doing himself harm. For the purpose it is best to have in attendance a cool-headed nurse. Failing in this, the sheet may be fastened over the patient in such a way as to prevent motion of the body, and the upper limbs fastened to the sides of the bed by padding the wrists with cotton batting and applying a bandage over this,

FIG. 289.—METHOD OF RESTRAINING PATIENT AFTER OPERATION.

which is tied to the side-bar of the bed (Fig. 289). The restraint should be removed as soon as quiet obtains. The treatment of shock has been fully discussed above (page 233). As soon as consciousness returns and the vomiting is a not marked symptom, the introduction of particles of ice into the mouth is permitted. This should be done by an attendant, and the patient not allowed to undergo the exertion necessary to self-administration. The use of ice may be alternated by teaspoonfuls of hot water given at frequent intervals, an indulgence which will help relieve thirst and is less often attended by vomiting than the former. It is well to remember that deglutition requires six seconds from the lips to the stomach, and that a small dose of hot water trickles very slowly along the esophagus and is not apt to contribute an important factor to the causation of dilatation of the stomach.

Thirst, which is the most constantly distressing symptom following celiotomy, may be relieved by the rectal administration of saline water (page 283).

As a routine, the writer orders a saline enema given in cases following celiotomy of 500 c.c. of a normal salt solution placed in the rectum every six hours. The first injection is made soon after the patient is in bed. This is not intended to relieve shock. If the latter be a factor in the case, the treatment is carried out as stated (page 233). It would seem that the measure controls thirst to some extent. The quantity of saline solution injected should never be sufficient to cause the lower bowel to rebel and expel it. Of course, larger quantities are most generally tolerated in this situation. However, this is probably only so when the tube is inserted high up into the bowel, a procedure which should be reserved for especial indications.

If vomiting persist after celiotomy, attempts at the administration of food by the mouth had best be entirely abandoned and rectal alimentation (page 291) given exclusively until vomiting ceases. Vomiting persisting into the second twenty-four hours following the operation should arouse suspicion of nephritis. If this be found to be the case, the usual treatment directed toward using the vicarious channels of elimination, *i.e.,* the skin and bowel, should be vigorously employed.

Nephritis following celiotomy occurs as the result of administration of ether and perhaps, too, owing to the congested condition of the splanchnic area from shock. It is not of necessity a seriously menacing condition if recognized early and made the subject of therapeutic attack. The administration of morphia in considerable quantity during the nephritis is contraindicated, though it must be borne in mind that, if pain be a factor in the case, its use may not be avoidable, and the attendant must use his best judgment in the individual case as to the dosage. It will be found difficult to withhold the drug entirely in some instances.

The quantity of urine excreted after celiotomy is usually small as the result of vomiting and the fact that the taking of food has been abstained from for several hours before the operation, together with the loss of blood attendant upon the surgical manipulations. If no fluid is introduced into the circulation soon after the operation the convoluted tubes of the kidney, theoretically, at least, should be engorged with solid excretory constituents. This condition of affairs, while not readily conceived of as of determining influence upon nephritis, is sufficiently objectionable to warrant attempts at furnishing the blood with fluid. At the end of twenty-four hours considerable quantities of fluid should be given by the mouth, provided vomiting has ceased.

Retention of urine after celiotomy is a common occurrence. Catheterization should not, however, be indiscriminately employed. The nurse is instructed to cause the patient to attempt to pass spontaneously the urine at the end of six hours following return to the bed. If the effort be unsuccessful, an attempt should be made every two hours and a total of twelve hours be allowed to elapse before the catheter is used. A record of the total quantity of urine excreted in twenty-four hours should be kept, with the view of standardizing the quantity of fluids administered. The patient's sensations with regard to the necessity for fluid is not always a reliable guide in this connection, as the administration of opiates may impair the sensorium. The catheterization must, of course, be executed under aseptic precautions. The catheter should be sterilized by boiling and kept in a vessel submerged in mild carbolic acid solution, in a convenient place. The meatus and contiguous parts should be gently wiped with a sterile gauze sponge, soaked with the same solution before the catheter is introduced. A chemical examination of the urine should be made every twenty-four hours for several days following the operation.

The administration of opiates may be stated as objectionable in principle, but necessary in a certain number of cases. The objections are that they paralyze peristalsis, which favors the formation of adhesions, that they lessen secretions and excretions, of which the latter is the most important factor, and that they mask symptoms which are indicative of complications. On the other hand, arrest of peristalsis is not objectionable for twenty-four hours after invasion of the lumen of the digestive tract, as it is easy to see that a wiggling gut will not heal as certainly as one which is immobilized. This is a principle with regard to repair of all tissues in all parts of the body. Again, pain which is sufficiently severe to cause restlessness and interfere with the exercise of the necessary after-treatment is best controlled, even if the objectionable features of the opiate have to be taken into account. Opiates are more readily avoided in cases which do not involve much intra-abdominal manipulation, *i.e.,* a ventral uterine fixation will not be followed by severe pain and an opiate need not be given. However, if there has been much trauma to the abdominal organs, pain may be a disturbing factor, and the use of an opiate be unavoidable.

Catharsis after celiotomy is employed early if the lumen of the digestive tract has not been invaded. Theoretically stimulation of peristalsis should tend to prevent the formation of adhesions. It must be remembered that the bowel has been quite thoroughly cleansed while the patient was being prepared for the operation, and that, aside from the fact that the intestinal canal is to be regarded as an important eliminative organ, catharsis is not urgently indicated. However, it is not improbable that a certain amount of decomposition of the intestinal contents takes place after celiotomy, the outcome of a relative intestinal paresis, and this results in the formation of gases which distend the gut and give rise to distress. It is the practice of the writer to administer in these cases one-tenth of a grain of calomel every half hour for twelve doses beginning the second day following the operation. When twelve doses have been given, three hours are allowed to elapse, and then a saturated solution of magnesium sulphate is given in doses of one drachm, for eight hours, unless catharsis is provoked before the entire half ounce of magnesium sulphate is administered. (Magnesium sulphate solutions saturate at 50 per cent.) In this event the administration of the magnesium sulphate is stopped when a movement of the bowels occurs. If no discharge of feces occurs after the entire half ounce of magnesium sulphate is taken, two hours are allowed to elapse and an enema of hot water is given.

Tympanitis after celiotomy is a common occurrence. It will be found that the measure stated above will have a tendency to control this occurrence. It is generally regarded as the outcome of intestinal paresis due to handling of the gut. It, of course, follows most frequently after abdominal operations involving the lumen of the gut itself, but does occur quite commonly when organs other than the gut are attacked. Especially is this true if it has been necessary to pack off large areas of the abdominal cavity with gauze, which packing is left *in situ* for a long period of time. Perhaps the most important causative factor in these cases is **intestinal paresis,** and treatment directed toward relief should contemplate correction of this condition of affairs. As already stated, the food administered immediately subsequent to celiotomy is of such a character as to involve little justification for the belief that it may be regarded as a determining factor in the problem. When distention occurs alimentation by the mouth should be restricted to water given in small doses and stimulation administered hypodermically or by rectum, if the indications for the same be presented. Strychnia in doses of one-thirtieth of a grain given under the skin at intervals of two or three hours, if not really of service as regards the relief from shock, serves the purpose of stimulating intestinal peristalsis. Doses of eserin of one-thirtieth of a grain, or, indeed, of one-fifteenth of a grain administered every two hours is a most effective agent in this connection, stimulating peristalsis and contraction of blood-vessels, thus aiding in raising blood pressure. If the distention be in the colon the introduction of a rectal tube of large caliber will afford considerable relief in a number of instances.

Atropin has been largely employed for the purpose, given in doses as high as one-tenth and even one-fifth of a grain. The writer has seen instances when this agent appears to have been successful in stimulating intestinal peristalsis, where other remedies have failed. It should, of course, not be expected to replace the mechanical means mentioned, but may be employed supplementary to them. It will probably be necessary to tie the patient down in bed after a maximum dose has been given, as delirium of maniacal quality is likely to occur. The atropin is administered hypodermically. The doses may be repeated in three hours. The writer has never felt justified in the administration of a third dose. It is, of course, to be borne in mind that the conditions present a desperately dangerous clinical aspect, and a measure which, under ordinary circumstances, is regarded as unjustifiable may become warranted under the circumstances. The application of turpentine stupes to the abdomen would seem to be of little service, for obvious reasons. The heat which the application develops may be of service in a general way, but this can be attained by other means which do not expose the patient to the irritating local effect which attends the application of turpentine to the skin. The retention bandage should be loosened at once and the question of acute dilatation of the stomach borne in mind. If relief is not quite promptly afforded, the stomach should be washed out. The special reasons for the latter measure have already been taken up.

The administration of agents designed to "settle the stomach" and remove gas is to be deprecated. The intestinal tract is in no condition to accept additional labor. The indication is clear, *i.e.,* to stimulate peristalsis and to remove by mechanical means the gas. Lavage of the colon with saline solution if ample provision for egress of the fluid is made is justifiable, as it may stimulate contraction of the gut. Distention of the gut, the outcome of intestinal paresis, is differentiated from that caused by peritonitis by the absence of the signs of inflammation attendant upon the latter. The differential diagnosis will decide quite definitely the question of reopening the wound, which question may arise in connection with inflammatory processes of the peritoneum following celiotomy. If the intestinal paresis be due to handling of the gut, an additional trauma will only add to the condition presented.

The administration of solid food following celiotomy should not be begun until there has been a normal evening temperature for three days. In cases which run an uncomplicated course the lighter articles of diet, such as chicken, squab, and broiled meat, may be given on the fifth day. A free evacuation of the bowels should precede the return to usual articles of diet. In cases in which the digestive tract has been invaded, solid food should not be given for ten days after the operation, despite the immediate favorable behavior of the case. Sufficient fluid or light diet may be given to sustain the general tone of the patient to obviate any hardship in this regard. In a general way, it may be said that less error will arise, if the precautions be carefully followed than if a policy of complacency be indulged in.

The time of leaving the bed in cases where the abdomen has been opened for any purpose should not be less than ten days following the operation. Much has been written in the current literature with respect to the early arising of patients after celiotomy. Some observers strap the abdomen very firmly after celiotomy with strips of adhesive plaster and permit the patient to get out of bed twenty-four or forty-eight hours after the operation. Remembrance of the complications which are likely to follow invasion of the abdominal cavity should be sufficient argument to show the fallacy of this procedure. It may be said quite emphatically that no repair of tissue is enhanced by motility, and that immobilization of parts subjected to trauma is an almost indispensable adjunct to repair, a lesson in nature one might well learn from the lower animals. In addition to this, the histology of the repair of tissue which has been sectioned will teach the rationale of the writer's contention. Any condition requiring invasion of the abdominal cavity is worth the hardship of quiet in bed for ten days to two weeks following the operation. Those conditions which would seem to permit of disregard of this rule probably did not require operative interference. In no case, including interval intermuscular appendectomy, should a patient subjected to celiotomy be permitted to assume the erect position for ten days following the section. And in all cases where the rectus is sectioned two weeks in bed should be the rule. Much unnecessary distress and, indeed, much adverse criticism of the science of surgery will be obviated if this is a common practice.

If primary union does not occur and the abdominal wound heal by granulation, the patient should be kept in the recumbent or semi-recumbent position until firm union of the muscular layer of the abdomen is attained. This requires several weeks in some instances. As soon, however, as the muscles are healed the patient may be permitted to leave the bed, even though complete cicatrization of the skin has not taken place. This is justified by the fact that the skin plays no part in retention of the abdominal contents.

When the patient is permitted to sit up or walk about, the abdomen should be firmly supported with an abdominal binder which is applied while the patient is still in the recumbent position, and the binder should be fastened from below upward. The

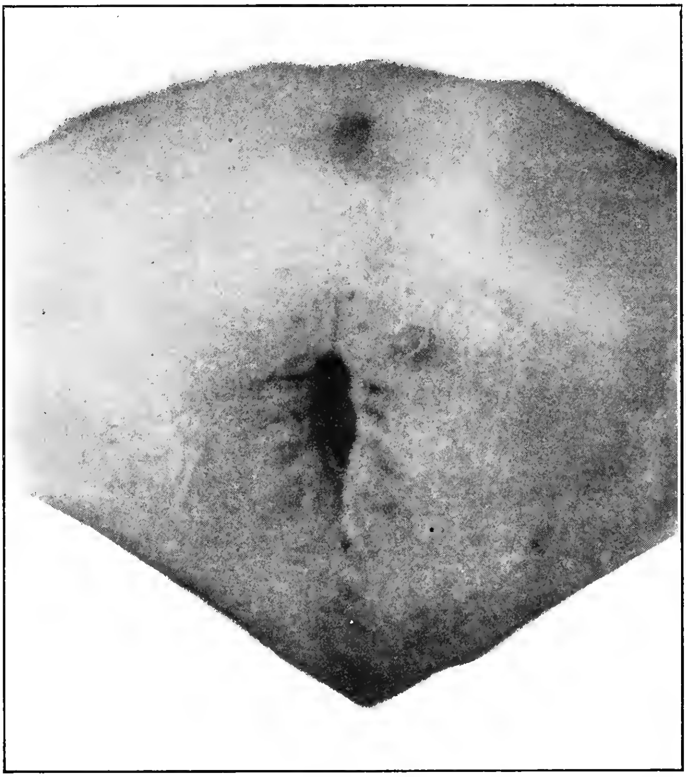


Fig. 290.—Granulating Wound Ready for Secondary Suturing.

wearing of belts and corsets following celiotomy is taken up under a separate head (page 475).

The removal of sutures after celiotomy depends upon the question of drainage and infection. In cases in which the wound has been closed up entirely, the sutures are left *in situ* until the tenth day. Of course, when catgut has been used, the sutures need not be removed unless the portion of the suture material buried beneath the skin is not absorbed at the end of the ten days. The use of catgut in the skin is, as already stated, inadvisable and, indeed, but little employed. The silk-worm gut sutures are removed on the tenth day, provided there be no indication for their earlier removal. In many instances it will be found possible to leave entirely undisturbed the celiotomy wound until the time for removing the sutures arrives. The method of removal of sutures is already described (page 304, *et seq.*). If there be infection of the superficial wound, it should be treated in the manner already described with respect to other situations of the body (page 305).

If infection of the superficial wound occurs after celiotomy,

FIG. 291.—GRANULATING CELIOTOMY WOUND APPROXIMATED WITH ADHESIVE PLASTER STRIPS. RUBBER TISSUE DRAIN *in situ*.

healing by granulation is an exceedingly tedious process, requiring change of dressings every forty-eight hours for several weeks. The scar following healing by granulation in this situation is of minor import in the male, but in certain cases the female patient objects strongly to the destruction of a certain cosmetic effect produced by a marred abdomen. In these instances the wound should be treated by cleansing and light packing until it is clean, and it may then be quite approximated by deep silk-worm gut sutures, which do not entirely approximate the lower angle of the wound. Fig. 290 shows a wound which cleaned up after three weeks of care, and now presents a condition favorable to secondary approximation.

The patient at times objects to narcosis and, indeed, to the injection of cocain solution. The latter is efficient for the purpose, the injection of a 1 per cent. cocain solution along the edges of the wound being quite devoid of pain. However, in some instances the manipulation is strongly objected to. In these cases the wound may, when the purulent discharge has quite ceased, be approximated with adhesive plaster, as shown in Fig. 291, care being taken to give room for egress of serum at the lower portion of the wound. Neglect of the latter precaution at times gives rise to an annoying dermatitis in the vicinity of the wound. Wounds which have been secondarily approximated in the manner stated at times heal with astonishing rapidity, and the residual scar is not of much greater breadth than obtains after primary union. The amount of time saved the patient by the little procedure is also a factor to be taken into consideration.

CHAPTER XXII

OPERATIONS ON THE ABDOMEN (*Continued*)

PERITONITIS FOLLOWING CELIOTOMY

Prevention of peritonitis: Flushing of the peritoneum—Treatment of peritonitis: The Murphy Treatment.

PREVENTION OF PERITONITIS

Consideration of the preparation of patients for celiotomy who are afflicted with intra-abdominal conditions which render the occurrence of postoperative diffuse suppurative peritonitis a likely complication, brings up the question of prophylactic measures beyond those involved in the operative technic. As a general rule, it may be said that the accidental introduction of infection into the peritoneal sac, as the outcome of the surgical manipulations, per se, is avoidable by close application to the rules of asepsis, and special measures, such as are about to be discussed, need not be considered in cases which are operated upon for the relief of non-infective processes. Indeed, it would seem that whatever experimental data is available in this regard, is of such a nature as to place the routine employment of systemic preparation with the view of lessening the probability of postoperative peritonitis in an objectionable light.

However, given a case of acute suppurative pyosalpingitis, acute suppurative cholecystitis or acute appendicitis with little or no evidence of peritoneal involvement and yet evidence of the presence of a virulent infective process in the situations mentioned, for the relief of which transperitoneal approach is to be made, it may be justifiable to make an effort to prepare more thoroughly the tissues for the contingencies involved in peritoneal infection. If invasion of the digestive tract is contemplated, the measure to be discussed should also be taken into consideration in those cases where an operation of magnitude is to be undertaken, such as partial resection of the stomach, resection of large portions of the intestine, or for the relief of intestinal obstruction, where adequate preparation in other regards is not feasible because of the urgency of the indications for operation. The disease itself, that of acute suppurative peritonitis, is a universally fatal affliction, though, indeed, many factors are to be considered in a given case, such as the character of the infection, etc., before a definite conclusion as to prognosis in a given case can be justly offered. The measures about to be discussed are not by any means in a position to be definitely offered as advisably used in any given class of cases. However, it would seem wise to suggest that they be given serious consideration in the class of cases alluded to.

Much experimentation has been carried on with the view of lessening the danger of postoperative peritonitis following abdominal section. It has been observed that the injection of various albumoses into rabbits produced at first a hypoleukocytosis and later a hyperleukocytosis. When animals thus injected were infected with various bacteria during hypoleukocytosis they died, but if the injection of pathogenic organisms was made during hyperleukocytosis, sufficient resistance was maintained to make recovery possible. The bactericidal value of normal blood was always greatest during increased leukocytosis. These favorable conditions were produced as the result of the injection of nucleins into the blood and, indeed, an increase of leukocytosis follows the ingestion of nucleins by mouth.

Mickulicz states:

The question arises whether artificial hyperleukocytosis may not be of value in practice as a prophylactic. According to the experiments of *Loewy* and *Richter*, or *Jakob* and *Hahn*, one cannot exclude the possibility that, by a partly anticipated mobilization of great masses of leukocytes, the latter may overcome the bacteria which had obtained entrance in the first instance in relatively small masses with greater ease, than if the leukocytes delay their attack in force, until the number and virulence of the bacteria in the tissues have markedly increased.

Experimentation carried on by *Miyake* under the directorate of *Mikulicz* seems to prove that the injection of nuclein in animals prior to the fertilization of the peritoneal cavity by organisms had an undoubted effect in lessening the occurrence of peritonitis. These experiments are summarized as

Consisting in performing a laparotomy and forcing through an opening in the stomach or intestine as much of their contents as could be obtained from the immediate neighborhood of the incision. Of five control animals which had not been previously prepared, four died from peritonitis between five and sixteen hours after the operation. The fifth became extremely ill but finally recovered, but the amount of intestinal contents which was transferred to the peritoneum was less in this case than in the others. Ten animals were prepared. These recovered without exception. The preparation consisted of three intraperitoneal injections of nucleic acid, two injections of neutralized nucleic acid. In each case laparotomy was performed seven hours after the injection. These experiments are such as to excite our interest in the highest degree, for by subcutaneous injection of nucleic acid, it was possible to raise the resistance of the peritoneum to such an extent that even a considerable quantity of intestinal contents could be placed in the peritoneal cavity without causing damage, whilst without previous treatment an acute, rapidly fatal peritonitis followed almost without exception. This opens out a new field for the surgeon in preventing postoperative peritonitis.

With regard to the application of the results of these experiments *Mikulicz* states:

The number of my experiments is not sufficient to permit me to form a definite judgment upon these points and to give an unguarded reply. We cannot, in the case of man, as we do in that of the lower animals when introducing infective material into the abdominal cavity, give a certain multiple of the minimum lethal dose in order to see how far a preventive treatment has succeeded. We set all our apparatus in action, in spite of preventive inoculation, to reduce infection to a minimum. Since this method fortunately succeeds in the majority of cases, even without preventive inoculation, in guarding the patients from a fatal peritonitis, a small number of satisfactory results do not prove much; but, on the other hand, one or two unsatisfactory results most certainly cannot condemn the method, for this method gives not absolute certainty like a specific immunization, but only increases the natural resistance, and this may, in certain circumstances, even when increased thirty-fold, nevertheless be insufficient. I have, however, the impression that the cases hitherto treated have given more favorable results, not only in the number of cases recovered, but, also, in the progress of the individual cases, than the analogous cases of earlier date where the operation was performed without this preparation. In 10 cases of resection of the stomach for carcinoma, 9 recovered, 6 of them without the slightest complication. The progress was marked by a smoothness that was quite exceptional before the treatment was adopted. Two cases which presented exceptional difficulty in the removal of the carcinoma did, undoubtedly, within twenty-four hours develop peritonitis, with a pulse up to 160, which according to our usual experience, foretold the most dismal prognosis. The patients fortunately survived the peritonitis. In the ninth case which recovered, the progress was disturbed from the fourth day by bronchopneumonia. The tenth case died; after seven days of uninterrupted progress, he developed pneumonia, to which he succumbed three weeks after the operation. Of the remaining operations, I should like to refer to 22 cases of gastroenterostomy and enteroanastomosis, 12 of which were for carcinoma. Of these cases, 19 recovered and 3 died. In all 3 cases death was most certainly not due to peritonitis, but in 1 case to perforation of an ulcerating carcinoma of the stomach two weeks after the operation; in another case, to continued hemorrhage from a carcinoma of the stomach sixteen days after operation; and in the third, to peritonitis arising from a tuberculous granuloma in the intestine four weeks after operation. Of 6 cases of resection of the intestine at one operation, 4 recovered and 2 died. In one case death occurred from collapse on the second day after a very prolonged operation of double resection for carcinoma; in the other case, where the injury was a bullet wound, death took place on the tenth day from hemorrhage from the vena cava. In neither of the cases was there any peritonitis. One case of opening the stomach and stretching the cardiac orifice, performed on account of spasm, recovered. So also did 6 cases of operation on the bile duct, 7 other operations upon abdominal organs without opening the intestinal tract, and 3 extra-abdominal operations. The last to be mentioned are 2 cases of nephrectomy, which were treated before the operation with nucleic acid. In both cases, in order to remove the suppurating kidney, the peritoneum had to be widely opened. One case recovered, the other died twelve days after the operation from hemorrhage from the renal artery. In this case, too, there was no peritonitis. We therefore have 45 laparotomies in which the abdominal cavity was exposed to infection by the contents of the stomach or intestines or by some other infectious secretion; 38 of these cases recovered, and in none of the 7 fatal results was peritonitis the cause of death.

Mikulicz has finally settled upon injecting 50 c.c. of neutralized nucleic acid, 2 per cent., twelve hours before the operation.

FLUSHING OF THE PERITONEUM

Flushing of the peritoneum with large quantities of saline solution and permitting a moderate amount to remain *in situ* after completion of the intra-abdominal operation is a practice quite largely employed by surgeons. It is probable that the resistance of the peritoneum to infection is increased by this means. It is wise to omit the measure, in the presence of considerable quantities of purulent secretion not widely distributed, for fear of spreading mechanically the infection. The most rational field of usefulness of the measure would seem to be in cases where the peritoneum has been subjected to considerable trauma for the relief of non-infective afflictions, such as carcinoma of the uterus or other neoplasms in this situation. The solution should have a temperature of 110° F., and be poured into the wound by means of a pitcher. About 500 c.c. of the solution is comfortably taken care of by the peritoneum in twelve hours.

The writer usually employs flushing after hysterectomy or transperitoneal nephrectomy, but omits it when the intestinal canal has been opened either with the view of relieving affliction or accidentally while operating upon contiguous organs. Whenever hemorrhage has been a factor in the procedure, the flushing is maintained until the solution returns clear, and then 500 c.c. of the fluid is left *in situ*. Under these conditions employment of the measure seems advisable. Peritonitis, of course, does not frequently follow this class of cases, and a standard as to its efficiency with respect to obviating its occurrence is not possible.

Kader uses an antistreptococcus serum with the view of immunizing the patient against peritonitis. While the measure has not proven of value as yet, it comprehends a field of endeavor which is along the lines leading to successful results in other connections, and for this reason reference to the matter should not be omitted in a work of this kind, if for no other reason than to stimulate investigation in this direction.

TREATMENT OF PERITONITIS

The occurrence of peritonitis is heralded by persistence of pain after the lapse of twenty-four hours following the operation. Its occurrence must be differentiated from the distress and distention, the result of intestinal paralysis. This subject has already been taken up. The condition of the vomit should be scrutinized. The occurrence of blood, more or less altered, in the vomit arouses suspicion of peritonitis, though it may indicate acute dilatation of the stomach. In the latter instance it appears early; the writer has seen small flecks of dark blood in the vomit, as the patient was being transported from the operating table. The patient had been subjected to celiotomy for hysterectomy, and infection before the operation was readily excluded. Within twenty-four hours an acute dilatation of the stomach supervened, though fortunately the patient made an excellent ultimate recovery, after appropriate measures of relief had been employed. It may be proper to regard a prognosis based on the appearance of so small a quantity of blood in the vomitus, as stated, a trifle pessimistic. However, liberal gastric lavage should be employed in cases where even a minute quantity of blood appears in the vomit after celiotomy, and, indeed, also if there be any doubt as to the conditions in this regard. The subsequent behavior of the case showed that infection had not occurred, and the wound healed by primary union. The contention that " black vomit " following celiotomy is fatal is true enough when it is the outcome of sepsis, but if it be due to acute dilatation of the stomach, recovery is not to be despaired of.

A discussion of the symptomatology of peritonitis does not belong here. However, it may be proper to state that the classical symptoms of inflammation as taught in school are the index in this situation as they are elsewhere in the body. As soon as the indications of peritonitis are manifest, an attempt should be made to empty the gut. The persistence of vomiting makes the administration of medicinal agents directed to this end quite impracticable. Calomel in small doses is, perhaps, most likely to be of service in this connection. High enemata, to which a few drops of turpentine have been added, are the means most likely to serve the purpose. If an expulsion of flatus and some feces attend the measure, the prognosis may be regarded as more favorable. The administration of eserin, atropin, and lavage of the stomach, as already indicated in connection with intestinal paresis, are measures of service. Reopening of the abdomen for the purpose of cleansing and draining the peritoneum, is a measure of doubtful utility. The shock of the first operation, the exhaustion attending the peritonitis, and the fact that additional trauma to the peritoneum and the necessary handling of the gut will all enhance the intestinal paralysis, would seem to lead to the conclusion that the measure is not properly to be expected to afford relief. However, this may be said, if the general condition of the patient warrants the attempt, if cyanosis, and venous stasis are not dominatingly established, the opening of the abdomen, at the lower median portion, and the introduction of hot saline solution may be justified.

THE MURPHY TREATMENT

The Murphy treatment has recently come much into vogue. *Gilliam* states the cardinal features of the Murphy treatment as "the Fowler position, pelvic drainage, and continuous drop-by-drop instillation into the rectum of a saline solution."

Gilliam states:

1. Drainage of the germ impregnated fluids into the pelvis, where absorption is least active, and away from the diaphragm, where absorption is most active, thus tending to diminish systemic infection. This is accomplished by means of the *Fowler* position.

2. Drainage of the pelvis to prevent stasis and accumulation of the peccant matters, which is in furtherance of the same object. The drainage is effected through tubes usually introduced through a suprapubic incision to the bottom of the pelvis, though on occasions the drainage may be affected through the vault of the vagina.

3. Surcharging the lymphatics with a saline solution to prevent their taking up and conveying into the general circulation the poisonous products of the pathogenic germs themselves. This is effected by rectal installation.

It is claimed that the saline infusion into the rectum is carried by antiperistalsis the full length of the large intestine, and in this way the area of absorbing surface is prodigiously increased. Now, inasmuch as the large bowel possesses both an absorbent and excretory function, I am of the opinion that the saline infusion serves a double purpose by creating both an endosmotic and exosmotic current, whereby the vascular channels are filled, on the one hand, with innocuous saline solution, and the excretory products, including the poisonous matters, are, on the other hand, swept into the bowel, to be carried away with the excretions. I have seen cases in which a diarrheal discharge of distinctly fecal character went hand in hand with evidence of absorption of the saline infusion and a gradual subsidence of septic manifestations.

Gilliam quotes from a communication sent him by *Murphy:*

In the last five years' work in general septic peritonitis, we have had forty-seven cases of perforative, diffuse, general peritonitis operated in the active stage, with but two deaths, and neither of these from peritonitis. The treatment after the operation in these cases consisted in placing and retaining the patient in the semi-sitting (*Fowler*) position (35 to 45°) for three or four days, administering large quantities of saline solution by rectum, from six to fifteen quarts in twenty-four hours; the saline must be allowed to seep in, the tube remaining constantly in position. No water is given by the mouth, as the stomach never absorbs it direct, and under these conditions it does not readily transmit it to the intestine for absorption. Mild catharsis should be induced with small doses of calomel, beginning eight hours after operation. During the transportation of cases of general suppurative peritonitis to the hospital, and during the operation the patients should be kept in a semi-sitting position. Use ordinary vaginal douche tips with three openings, so that the water can flow into one and the gas come out of the other. A single opening tip will not permit the gas to bubble back into the can, and the passing of gas is important. The can should be elevated from four to six inches above the anal level. The tube can be strapped permanently to the body (the thigh) of the patient with adhesive plaster, and the nurse should be carefully instructed to watch closely and not allow more than one and a half pints of saline solution to flow in from forty minutes to one hour. The speed of the flow must not be controlled by forceps on the tube, but by elevation, or depression, of the can. A hot water bag should be used to keep the solution warm. (The can is replenished every two hours.) There is no irritation of the rectum and the tube is not taken out for days, the time varying in different patients and depending on the virulence of the infection. Through the drain, the tension of the pus is kept low. With the saline irrigation, these patients have increased urination and increased perspiration when the blood pressure is restored.

Gilliam employs for the purpose of maintaining the *Fowler* position an adjustable chair, which is not unlike the so-called steamer chair used by travelers, which he describes as

Consisting of a canvas body rest or hammock, supported by a wooden frame work, and as its name implies, it is capable of being thrown into various positions ranging from the upright to, or near the horizontal. It is provided with a leg rest which is also capable of being raised or lowered. Incidentally, it is light in construction and can be folded into a small compass for easy transportation.

Fig. 292 shows a patient postured as described with the irrigation can placed in about the proper relationship to the anal level. The purpose can be achieved by raising the head of the bed or by

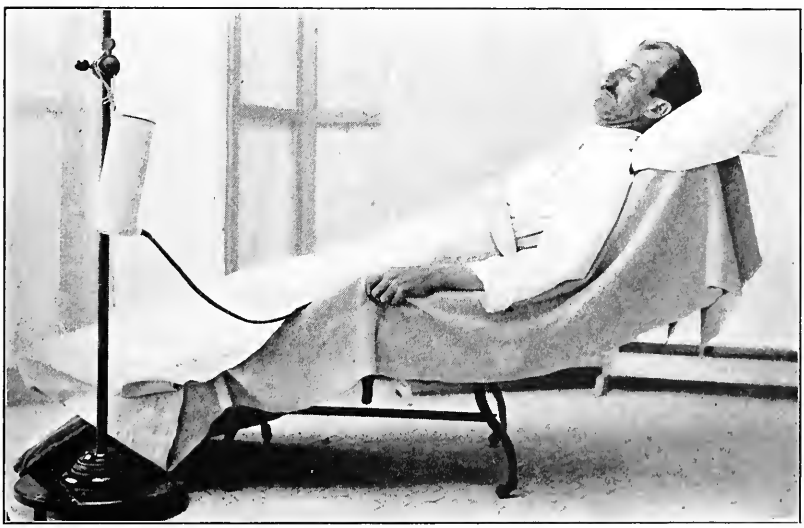


FIG. 292.—PATIENT IN THE *Fowler* POSITION BEING GIVEN THE *Murphy* INSTILLATION INTO RECTUM.

placing a bed rest beneath the patient's body at an angle of 35° to 45°. It will be found expedient to place the patient's buttocks on a goodly sized rubber ring, to obliterate the acute angle which the tube forms to the position of the body. The latter may kink the tube. A return flow is, of course, not provided for, for obvious reasons. Undue exertion on part of the patient is to be avoided for the reason that drainage of the abdomen favors sequential ventral hernia.

The class of cases in which drainage is efficient is those in which purulent peritonitis already exists, and here dependent drainage may accomplish the purpose in contradistinction to those cases in which drainage is introduced as a prophylactic measure, with the view of preventing infection. This phase of the subject has already been discussed.

The tube drainage should be removed as soon as the discharge of purulent secretions ceases. This is usually feasible on the third or fourth day. If improvement in the general conditions occurs at the end of twenty-four hours, rectal alimentation may be made for one injection and the irrigation interrupted for three hours. The introduction of nutritive elements by mouth will be found to be quite impossible during the time that the indications for continuous instillation exist. As soon, however, as the stomach tolerates liquids gastric alimentation, under the precautions stated, should be begun.

When peritonitis follows celiotomy the patient should not be permitted to leave the bed until convalescence has been well established.

CHAPTER XXIII

OPERATIONS ON THE ABDOMEN *(Continued)*

COMPLICATIONS IN CELIOTOMY

Lung complications—Parotitis—Hematemesis—Phlebitis and thrombosis—Adhesions following celiotomy—Abdominal belts and supporters.

LUNG COMPLICATIONS

Pathological processes in the lungs follow celiotomy more frequently than operations in other situations of the body. The advent of asepsis has lessened the number of instances in which these complications occur, but there is still a preponderance of lung disease following celiotomy as compared to other operations. Pneumonia, pleurisy, bronchitis, pulmonary edema, embolic infarcts, and abscess of the lung are the processes most commonly encountered. They may follow simple or severe operations.

The belief that the afflictions were due to chilling of the lung tissue by ether was abandoned when the same complications occurred subsequent to operations made under local anesthesia. *Moynihan* says:

> It is well known that for a few days after any abdominal operation, the wound may feel stiff and sore, though it is not actually painful. The taking of a deep breath or the act of coughing causes a sudden "stitch" in the wound, and the patient feels as though a free effort at coughing would tear the wound edges apart.

It was suggested then that immobilization of the abdominal muscles, in the unconscious protection of the wound area by the patient, resulted in an accumulation of the bronchial secretions in the lung. A deep breath was not taken; the breathing remained thoracic in type, and the air passages were not cleared in the act of coughing. The lung then became irritated and waterlogged by retained secretions. In favor of this suggestion is the fact that all forms of chest involvement are more frequent after operations performed in the upper abdomen.

A factor which is, without question, one of great importance is the chilling of the patient before, during and after the operation.

The precautions necessary in this connection are already taken up (page 162).

Moynihan further states:

In some cases I feel sure that the cause of the lung implication is to be found in the inhalation of septic matter. This septic matter may come from the patient's own mouth, or it is conceivable that a dirty inhaler may be responsible for it. Of the necessity for cleanliness in both these directions there is no further need to speak.

In some cases the pneumonia has been proven to be due to embolism, the septic emboli being derived from the operation area. In operations upon the stomach or intestine in particular, thrombosis of veins may result from unduly rough handling or from infection of the wounds. Neatness and a certain dainty fastidiousness and the utmost cleanliness in all operations are things to be cultivated.

There can be little doubt, I think, that in some cases the long continuance of the *Trendelenburg* position in pelvic operations is productive of harm. The viscera are pressed against the diaphragm, whose freedom of action is thereby limited. There is a congestion of the lungs as a result of the gravitation of blood to the dependent parts. It is my custom to perform the early and late steps of any pelvic operation with the patient in the usual horizontal. As soon as the Trendelenburg position is necessary, the table is altered by the anesthetist in a moment; as soon as the pelvic part of the operation is completed, the table is again made horizontal. The patient, therefore, remains the briefest possible time in this constrained position.

It has become a general custom, more especially among resident officers, to give intravenous saline injections to all patients who are suffering in any serious degree from shock. The custom has much to recommend it, but I am strongly disposed to think that it is not seldom provocative of harm, for, in some cases, when large quantities of fluid are injected, an acute edema of the lung, with copious frothy expectoration, occurs. On postmortem examination of such cases, it can be seen that there is an acute edema of both lungs, the lungs, in fact, are waterlogged. Saline infusions are remedies we cannot afford to do without, but a little more discretion than seems generally customary should be exercised in their administration. Above all, it should be seen that the fluid injected is of proper temperature, that no air is allowed to get into the vein, and that the quantity injected does not exceed three pints. As much as five or six pints has been frequently given, but I do not think that as much benefit results from one large injection as from two smaller ones given with an interval of twelve or twenty-four hours.

Professor *Mikulicz* orders all his patients, after abdominal operations, to breathe deeply for a few minutes two or three times daily, in the belief that the tendency to stagnation in the lung bases is thereby relieved and broncho-pneumonia prevented.

From the foregoing discussion it will be realized that, though the possible causes or influences giving rise to the lung complications after abdominal operations are many, it is not to any one of them that paramount importance can be attached. The surgeon's part, therefore, must be to safeguard his patient by all means in his power from all these harmful influences, and he will find that by so doing the risk of the occurrence of these most serious disasters will be greatly lessened, if not entirely abolished.

The treatment of the lung complications following abdominal operations does not differ from that which is observed in the cases ordinarily seen. I have come to place much reliance upon the frequent use of the steam inhaler with or without tincture of benzoin or other stimulants. The patient always expresses himself as much relieved, and a copious expectoration generally results from each use of the inhaler. A mixture containing digitalis, vinum ipecacuanha, and carbonate of ammonia generally gives relief.

Bibergeil in 3,909 operations in *Korte's* clinic found that pneumonia followed in 135 of the collected cases, and presented in 10 instances the croupous or lobar, in 98 the lobular, and in the remaining 27 the hypostatic form. Other complications, such as pulmonary embolism and abscess, bronchitis, pleurisy, and empyema, occurred in 147 other cases. With regard to pneumonia, *Bibergeil* found that this complication of abdominal surgery was in no wise influenced by the condition of the wound. Of the 10 cases of the septic lobar pneumonia type, in 8 the wound was aseptic and septic only in two. He states that:

A careful study of the collected cases has led to rejection of the views that this complication may be due to infection by way of the lymphatics, and to such causes as exposure to cold of the surface of the body or of the peritoneal cavity to abdominal irrigation, and to direct action of the anesthetic. The lobular form, or bronchopneumonia, which is most frequently met with after laparotomy, is regarded as being usually the result of autoinfection, due to the aspiration of secretions from the mouth and pharynx, whilst the patient is under full influence of an anesthetic.

It is pointed out that the interference with free breathing and expectoration, resulting from pain at the seat of the operation and impeded movements of the incised abdominal wall, must favor very much the development of lung disease after laparotomy, while the resistance to the inflammatory attack is in many cases much impaired in consequence of the enfeebled condition of the patient. In concluding, the author recommends, as suitable prophylactic measures, thorough cleansing of the mouth and throat and irrigation of the stomach before the operation; a cautious administration of the anesthetic, the patient's face being turned to one side to permit a free external flow of oral secretion; prevention of chilling of the surface of the abdomen during and after the operation; the application of thick and warm compresses to the wound, and avoidance of tight bandaging; frequent change of the patient's position in bed during the after-treatment, and as speedy a release from the recumbent posture as the state of the wound will allow.

The fact, as already stated, that lung complications follow abdominal section when local anesthesia is employed, suggests that some of the causative factors are due to the factors which *Bibergeil* enumerates. It must not be forgotten, however, that septic emboli do locate in the lung which may have their origin in the field of operation, and no local evidence of sepsis in the postoperative course of the case be manifested. This is readily understood, from a physiological viewpoint, when the arrangement of the abdominal circulation is borne in mind. Indeed, abscess of the lung and empyema pleuritica has frequently followed abdominal section when the abdominal wound did not indicate septic infection. Indeed, the same condition, *i.e.,* abscess of the brain and fatal meningitis, has occurred under the same conditions. Pneumonia and pleurisy complicating abdominal section are both more liable to be followed by empyema than the ordinary type of both these diseases.

If all the precautions mentioned be carried out, many factors which may properly be regarded as causative to lung complications following celiotomy will be eliminated. The attendant is warned, however, against eliminating the question of chilling the patient before, during, or after the operation. Complacency in this regard, the outcome of the assumption that mechanical factors play the most important rôle in causation, is to be deprecated. So it is with respect to change of posture in the so-called hypostatic pneumonia. The hypostasis is most likely to occur in old and enfeebled persons, and, while it is true that the recumbent position favors gravitation of fluids to the bases of the lungs, it is also true that the sitting posture is not without danger to the patient's heart under the same conditions. The upper portion of the body should be cautiously elevated, under careful espionage of rate and character of pulse, and when marked alteration in these regards becomes manifest, the recumbent position is to be again attained. Under no circumstances is the patient to be permitted to assume the upright position as the result of muscular effort. In some instances the lateral positions, varied as to the side turned upon, would seem to be a rational indulgence. This, too, should be done by the attendant and not be the result of exertion on part of the patient.

PAROTITIS

Parotitis, that is an acute inflammation of one or both parotid glands, is another occurrence quite common following abdominal section. In 1887, *Stephen Paget* collected the records of 101 cases and investigated their causes. He found that in 10 cases parotitis arose after disease or injury of the urinary tract; 18 cases, parotitis arose after disease or injury of the alimentary tract; 23 cases, parotitis arose after disease or injury of the abdominal wall, peritoneum or pelvic cellular tissue; 50 cases, parotitis arose after disease or temporary derangement of the generative organs.

It has been believed that the preponderance of cases following abdominal section for disease of the genital organs was due to the fact that the opening of the abdominal cavity for pelvic disease was more frequently undertaken than for other intra-abdominal afflictions. Also, that heretofore the custom was not to supply water to the system following celiotomy, and that the dry, parched condition of the mouth favored inflammation of these glands. It is worthy of note, however, that surgical attack of the female generative apparatus is followed quite frequently by tonsillitis, even now, when copious amounts of fluid are introduced into the system after celiotomy. It is also true that tonsillitis frequently occurs in the newly married. It would seem that, as far as the generative organs is concerned, there is a peculiar relationship between them and the tonsillar and parotid tissue, one which is not readily explained.

The significance of the subject lies in the confusion the occurrence of complications of this sort give rise to, with regard to standardizing the systemic symptomatology with respect to wound complications. The acceleration of pulse rate, and increase of temperature coincident to the complications mentioned, arousing suspicion of other more directly sequential conditions.

The occurrence of parotitis, secondary to celiotomy, has been ascribed to several causes. It was at first regarded as a primary mumps, until the marked difference with respect to the tendency to suppuration in the secondary form became accepted as justifying a different conclusion. The pyemic or embolic theory was the one to first receive general approval. Before the advent of aseptic repair of wounds, this conclusion seemed rational enough, but latterly, as the condition obtained in the course of nonseptic wound repair, the theory was discarded. Indeed, in those instances in which infection of the celiotomy wound did occur, there was frequently no evidence of thrombosis which would justify the belief that the suppurative parotitis was embolic. Of course pyemic parotitis does occur in the course of sepsis, but then develops as a part of pyemic processes in other situations.

Bucknall states:

More recently the question of embolic origin has been definitely proven to be incorrect, for it has been shown by microscopical examination that the conditions present are different in secondary parotitis and in parotitis of pyemic origin. In the former instance, the process of inflammation begins around the ducts in the centers of the lobules and, moreover, many lobules are simultaneously affected. In the latter (pyemic type), the inflammation begins around the arteries which run in the perilobular tissue and the inflamed mass is a single one, involving the area of gland tissue supplied by the particular vessel which has been blocked by the septic clot.

Paget leans toward the sympathetic theory already alluded to, on the ground of the peculiar relationship between the organs of generation and the parotid gland. *Moynihan* does not regard this relationship as of determining import, believing the process in the glands as always infective and extending from the mouth. This view is strongly supported by *Hanau* and *Pilliet.*

Bucknall presents this view as follows:

They found on microscopical examination of sections of the parotid (1) that the ducts were choked with débris containing micro-organisms; and (2) that the inflammatory processes present invariably

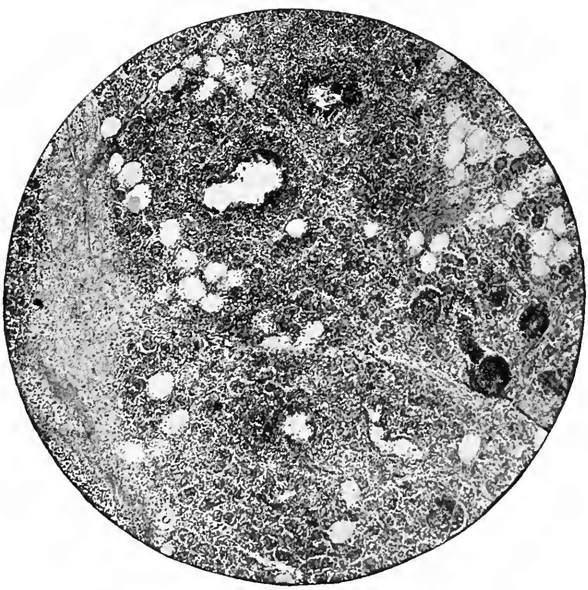


Fig. 293.—Parotitis. Infected Ducts and Adjacent Central Parts of Lobule Breaking Down to Form Abscess Cavities. *(Rupert Bucknall.)*

began around the ducts in the center of each lobule, and only spread later to the periphery of the lobule and the perilobular connective tissue in which the blood vessels are situated. They concluded, therefore, that secondary parotitis could not be of embolic origin, or else the inflammation would have originated around the vessels, and that the fact that inflammation began simultaneously in the centers of many lobules at once. pointed to an ascending infection of the ducts as the real source of the affection,—a conclusion which was further borne out by the actual presence of microörganisms in the ducts themselves in such cases.

Additional evidence of different kinds has been subsequently brought forward in support of this view.

Microscopical sections serve to show that in all cases of secondary parotitis, the disease pursues the following course: (a) The ducts become blocked with débris (Fig. 293). (b) Inflammation first begins in the center of each lobule around the ducts, and at a point farthest away from the vessels (Fig. 294). (c) Many lobules are

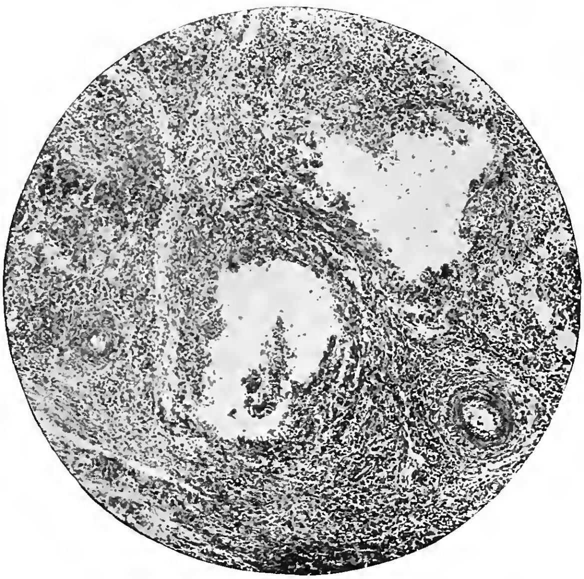


Fig. 294.—Parotitis. Gland Tissue Destroyed and Replaced by Inflammatory Products, Which are Breaking Down to Form Abcess Cavities, Vessels not Thrombosed or Specially Inflamed. (*Rupert Bucknall.*)

simultaneously affected; they each become centrally necrosed and then finally, by extension, they fuse to form a multilocular abscess. (Fig. 295.)

Bacteriological examination, first carried out by *Girode,* has served to prove: (a) That several different kinds of organisms may give rise to secondary parotitis, the commonest being the staphylococcus, the next frequent the pneumococcus, and after that the pneumobacillus, the typhoid bacillus, and the streptococcus, in order of frequency.

(b) That on taking cultivations from the gland itself, the pus contained in it, the orifice of *Stenson's* duct, and the oral cavity respectively, the organisms found at each spot are invariably identical in each individual case, a fact which supports the conclusion that the infection of the gland spreads from the mouth via the duct. (c)

FIG. 295.—PAROTITIS.' SHOWING MULTILOCULAR ABCESSES IN DUCTS AND GENERAL CELL INFILTRATION OF LOBULES. (*Rupert Bucknall.*)

That the organism giving rise to secondary parotitis is by no means invariably the same as that giving rise to the primary disease, during the course of which the attack of parotitis has arisen. Thus, in the cases complicating pneumonia, the organism causing parotitis may be the pneumococcus or the staphylococcus; in typhoid fever, it may occasionally be the typhoid bacillus, but it is much more commonly the staphylococcus or pneumococcus. In embolic parotitic due to pyemia, on the other hand, the organism in the parotid is invariably identical with that giving rise to the primary disease and the abscesses in other parts of the body.

The treatment of parotitis does not differ from that of acute inflammatory processes elsewhere in the body. The discussion related above argues for cleanliness of the mouth prior to operation (page 362).

HEMATEMESIS

Hematemesis following celiotomy and its significance has been made the subject of extensive discussion under postoperative vomiting and acute dilatation of the stomach. A repetition of this would be out of place. The reader is referred to these portions of the work for guidance.

PHLEBITIS AND THROMBOSIS

Phlebitis and thrombosis are not infrequent occurrences, complicating abdominal section, though, indeed, they are almost usually sequential to operations on the pelvic organs, especially hysterectomy, but have also occurred following attack upon the other abdominal organs, including the stomach and gall-bladder.

In the vast majority of cases the phlebitis occurs first, and the formation of the thrombus is secondary to it. However, in some instances, especially where there is an impoverished condition of the blood, the so-called "marasmic thrombosis" of *Billroth* occurs, which the latter attributes to increase of the coagulability of the blood, due to an increase in the proportion of calcium salts.

The phlebitis is due, almost always, to infection, though it does also occur when the wound runs an aseptic course. It will be noticed, however, that even though the wound itself presents at no time evidence of inflammation, the so-called reactionary temperature, on the second day following the operation reaches $101\frac{1}{2}°$ F. The notion that infection is the causative factor in phlebitis is not absolutely accepted by all surgeons. The fact that it occurs most frequently after hysterectomy, during which, of course, an infective area is invaded, would argue for the accuracy of the infection theory. Phlebitis has also occurred after interval appendectomy, but it must be remembered that the veins of the mesoappendix are intimately connected with the contiguous large venous trunks, and that an infection not of sufficient virulence to manifest itself at the port of entrance, may still find the conditions for a favorable culture medium in a contiguous vein.

The saphenous and femoral veins on the left side are the ones most frequently involved. *W. W. Keen* regards the fact that the left common iliac vein passes under the right common iliac artery, as a possible indirect cause of the preponderance of cases of infection of the veins on the left side. Though this explanation is not easy to accept, it may be said that there is a certain causative relationship possible. Summarizing the subject of venous thrombosis and phlebitis, *Moynihan* says:

> Thrombosis occurs most frequently following abdominal operations upon the lower part of the abdomen. It is estimated to happen in 2 per cent. of all cases; it is first noticed about two weeks after the operation; it is more apt to afflict patients who are debilitated by long illness, or whose condition is poor as a result of frequent hemorrhages; it is found in great preponderance upon the left side, where it affects the saphenous and femoral veins. As a causative factor, sepsis can rarely be excluded. Phlebitis precedes the thrombosis as a rule.

Cordier has collected records of 232 cases. He gives the following table, which shows the number of cases following various operations:

Nephorraphy	9
Appendectomy—mostly so-called aseptic cases	27
Cholecystotomy	4
Oöphorectomy (cystic, scirrhotic, etc.)	16
Hysterectomy, fibroids, so-called aseptic cases	69
Vaginal operations, character not stated	8
Alexander's operation	3
Hernia	4
Pyosalpinx	7
Pelvic operations not specified	9
Abdominal and pelvic operations not specified	56
Ectopic pregnancy	4
Vaginal hysterectomy for cancer	9
Suspension of uterus	7
Splenectopy	1

SPECIAL FEATURES

In 213 cases, left saphenous or femoral veins affected.
In 8 cases, both left and right veins affected.
In 11 cases, right veins alone affected.
In 182 cases, proximal part of vein first affected.

In 36 cases, distal part of vein first affected.

In 14 cases, portion of vein affected not mentioned.

In 166 cases, sepsis was not present at time of operation.

In 56 cases, no mention of sepsis or asepsis was made.

In 10 cases, there was pus present at time of operation.

In the great majority of cases the first symptoms appeared from the 19th to the 15th day.

In 6 cases, pleuritic and lung complications.

In 3 cases, sudden death occurred.

Cordier describes the clinical course as follows:

The usual onset of this condition is marked by a gradually increasing pain along some portion of the long saphenous vein, usually the left, and most frequently just below the saphenous opening in the fascia lata. This pain may extend along the whole course of the vein and, as a rule, does follow the vessel below the knee. An elevation of temperature of from 2° to 3° is noticed, and a proportionately increased pulse-rate is also observed. The pain in the limb is increased by moving the limb or by permitting it to remain in a dependent position, and is partially relieved by elevating the leg and thigh. On examining, in many cases, there will be noticed a redness along the course of the inflamed vein or veins. If seen early, no perceptible swelling of the limb will be noticed, but within a few days, if the case is a severe one, the whole limb will be swollen, but more particularly the calf of the leg. This swelling is uniform, and free from discolorations or redness; in fact, the surface is blanched. Pressure along the course of the vein elicits tenderness, and in the calf of the leg the tenderness is found all over the posterior surface. The vein is hardened and rolls under the finger like a tendon, in many cases. Pressure, if continued for several minutes, may produce pitting, but not so well marked as in dropsical afflictions. Except along the course of the superficial portion of the vein, which may feel unnaturally warm, there is a death-like temperature of the surface to the examining hand.

The patient should at once, immediately upon recognition of the affliction, be warned of the serious outcome which may attend disturbance of the limb. The affected limb should be elevated on several pillows, and warm applications, of boracic acid, lead, and opium wash or simple water be made. The limb may be incased in a many-tailed bandage, and thus the applications may be made to the sides and front of the limb without disturbing it. Heat in some form will be found soothing and agreeable to the patient. If the phlebitis begin sufficiently far down in the course of the vein, the *Bier* passive hyperemia should be tried. The writer has found this treatment of apparent service in cases which permitted of the constriction being placed above the seat of inflammation.

Cellulitis suppuration and abscess rarely occur, and must be met in the usual way when they become manifest. In some instances it would seem advisable to cut down on the vein near the saphenous opening, deligate it and remove the thrombus. This latter measure has been found of signal service in a number of cases observed by the writer.

The precautions with regard to keeping the limb quiet must be assiduously observed for several weeks, until there is a reasonable assurance that the process has subsided. Disregard of these precautions has in no small number of instances resulted in dislodgment of the thrombus, and embolic invasion of the lung and heart with sudden death.

The intravenous injection of collargol has proven useful at the hands of some observers. Its employment would seem justified, if the phlebitis constantly recur after apparent subsidence of the primary attack. Its use must be carefully executed, and this under aseptic precautions, together with careful observance of the rules laid down with respect to intravenous medication.

ADHESIONS FOLLOWING CELIOTOMY

Adhesions following celiotomy are quite unavoidable. They, of course, do not always occur to a considerable extent following celiotomy undertaken for non-infective processes. However, they do occur in a certain number of cases of this sort, and may be regarded as inevitable consequential occurrences subsequent to operations where peritoneal inflammation exists, or is provoked as the outcome of surgical trauma.

The avoidance of prolonged drainage and unnecessary manipulations within the abdomen during the operative procedure may be regarded as determining factors with respect to causation.

It may be said that the introduction into the abdomen of various mechanical substances with the view of obviating the occurrence of adhesions has not been attended by favorable results in this connection. The administration of cathartics, and leaving a certain amount of saline solution in the peritoneal sac, are measures which theoretically should be of some benefit. So is it with regard to the administration of atropin and eserin.

A discussion of the consequences of the formation of adhesions in the peritoneum and the organs it covers does not belong here. It is, however, proper to state that mechanical obstruction of the gut follows in a certain number of cases which have been subjected to intraperitoneal surgical trauma, and that the obstruction is most likely to follow cases in which the lumen of the gastrointestinal tract has been invaded. The symptomatology is that of intestinal obstruction and, as a rule, does not present itself until weeks after the operation. When the patient has overcome the intestinal paresis and there has been an interval of from several days to weeks of intestinal patency, as shown by the free evacuation of feces and gas, and then symptoms of intestinal obstruction develop, the case may quite properly be regarded as one of mechanical obstruction due to adhesions.

The measures of relief justified when the obstruction is due to intestinal paresis, which involve stimulation of the gut, should be avoided and the case at once subjected to celiotomy, destined to remove or obviate the cause of obstruction. This postoperative complication is most distressing, calling, as it does, for a secondary major operation in a case already subjected to severe measures. It is, however, urged that the attendant do not permit these considerations to stand in a causative relationship to delay in the attempt to obviate the difficulty.

It would seem that massage of the abdomen as soon as convalescence is established, should have a tendency to obviate the formation of adhesions, or at least to aid in stretching those already formed, thus, from a theoretical viewpoint, possibly avoiding obstruction by kinking. It is, of course, quite impracticable to conclude as to the value of the massage. However, as persons who have been subjected to celiotomy are apt to be in poor general condition following the operation, employment of abdominal massage may be justified on the ground of the general benefit as regards tone of the gut, which follows its judicious use. A patient who has been subjected to celiotomy most always relaxes the abdominal muscles when in the upright position, bringing the thorax nearer the pelvis in an effort to relieve the tension on the abdominal muscles. This posture is a favorable one as regards postoperative hernia, and, if carried on for a long time, results in a certain amount of disuse atrophy of the muscles. This is, of course, objectionable, and also so because of the round-shouldered pose of the patient. Some of this is frequently the outcome of timidity, and is seen more often in females than in males. In these cases massage of the abdomen achieves a double result, stimulating peristalsis and toning up the muscles in the abdominal wall.

A not inconsiderable number of patients are victims of constipation following celiotomy, for obvious reasons. Massage provokes a favorable outcome in this connection. Electricity applied to the abdomen at intervals is a measure which may be regarded as of service in these cases.

ABDOMINAL BELTS AND SUPPORTERS

It is common practice to supply patients who have been subjected to celiotomy with some form of abdominal supporter which is to be worn for periods varying from several to six months following the operation. Much has been said with respect to the superfluity of the measure. As a matter of fact, the apparatus does no harm, and probably is indicated when the section is made below the umbilicus. In young persons or in women who have not borne children, the belt or supporter may be dispensed with, provided primary union has been obtained in the wound. Even in the cases last mentioned, if the wound has healed by granulation, some form of abdominal supporter should be worn for several months after convalescence is established.

Later in adult life, that is, after thirty-five, the abdominal walls of all individuals undergo certain changes. The ribs flare out at their lower aspects, and the abdomen attains a certain rotundity, which is not necessarily due to the deposit of fat. This is due in part to relaxation of the muscles, and in part to a physiological "dropping down" of all of the abdominal viscera including the liver. Especially is this true in women who have borne several children. The strain in these instances of the intra-abdominal pressure is brought to bear upon the lower two quadrants of the abdomen, and, if a portion of the abdominal wall is weakened as the outcome of section, hernia is liable to occur. It is the writer's belief that a well-fitting abdominal sup-

Fig. 296.—Method of Strapping Abdomen. Preliminary Step. (*Kemp.*)

porter tends to support the abdominal wall and lessens the chances of hernia, certainly during the first few months following abdominal section. It is to be remembered, though, that the supporter should be removed at night and massage and exercise of the abdominal muscles practiced, with the view of obviating the undoubtedly objectionable resting of the abdominal muscles, which may be the outcome of the constant wearing of an artificial support in this situation.

The influence support has on the lower two quadrants of the abdomen is illustrated by testing the effect of strapping with adhesive strips. *Kemp* employs the method shown in Figs. 296, 297, 298. The strapping may be done in the way shown, beginning from below with the patient in the recumbent position, immediately subsequent to the operation, and these may later be replaced with a belt. This method of procedure is especially useful, following operations made necessary by enteroptosis. The material employed is two and a half inch moleskin, zinc oxid plaster, and each strip is carried around behind to the median line, in the oblique direction indicated in the illustrations. It will be seen in the illustrations that the strips of the second layer (Fig. 297) cross those of the first, and then all the straps are finally held in place by a third layer of transverse straps

Fig. 297.—Method of Strapping Abdomen. Second Step. (*Kemp.*)

placed over the points of crossing of those underneath (Fig. 298). If the celiotomy wound be not quite healed, it is dressed with a few layers of sterile gauze and the straps made to cross the wound.

The straps, of course, have to be changed at each subsequent dressing. Repeated strappings are not conducive to a healthy condition of skin, and the measure is to be regarded as simply a

Fig. 298.—Method of Strapping Abdomen. Final Step. (*Kemp.*)

temporary one, to be followed by apparatus, as is described further on.

It is not sufficient to give the patient general directions, to go to an instrument maker or to send to one and purchase the supporter. The attendant should make the measurements himself, and see the supporter in place in order to determine whether the intent has been attained.

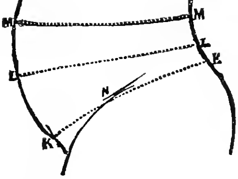


Fig. 299.—Lines of Measurement for Abdominal Belt.

The necessary measurements are shown in Fig. 299. The illustration speaks for itself, the dotted lines representing circumference. M should be taken about eight inches above the pubis, L corresponds to the umbilicus; these two measurements are horizontal. L begins at the pubis in front, and crosses the ilium just below the anterior spine N and extends ascendingly backward to a point four inches below the posterior aspect of M.

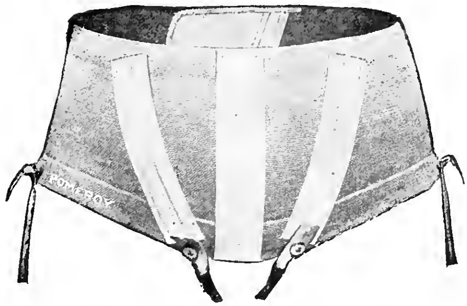


Fig. 300.—Abdominal Supporter Used after Celiotomy.

The supporter should be of elastic material, cotton or silk, depending upon the financial condition of the patient. The character of fabric is not essential as long as the elasticity is sufficient for the purpose.

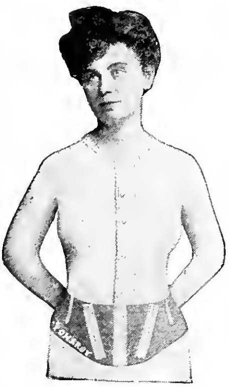


Fig. 301. — Abdominal Supporter in Position.

Fig. 300 shows a supporter made of elastic fabric which is strapped behind. The two hooks are for perineal bands, which are shown in part attached to the posterior lateral aspect of the supporter. This apparatus is simple and effective. The belt may be made to lace on the sides over the hips in cases where the abdomen is boat-shaped and the ilii prominent. The kind shown in the cut will be found effective in the majority of instances.

Fig. 302.—Abdominal Supporter and Corset Combined.

The patient must be instructed to apply the supporter while in the dorsal position with the hips elevated. Fig. 303 shows the position which the patient should assume while applying the apparatus. This position gravitates the viscera toward the diaphragm, and the supporter maintains them there to a relative extent. Fig. 301 shows the supporter in position, being worn over

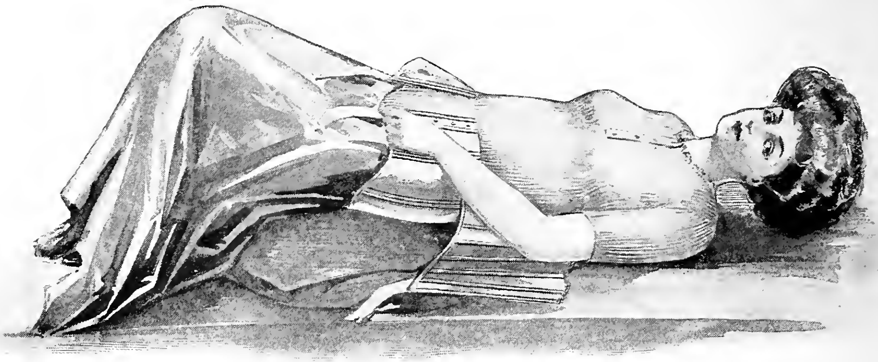


Fig. 303.—Adjusting Lower Segment of Combined Abdominal Supporter and Corset.

the undergarment. The perineal straps are not shown, but should always be employed to prevent the supporter from slipping upward, the latter contingency causing pressure from above, which, of course, is more undesirable than wearing no support at all.

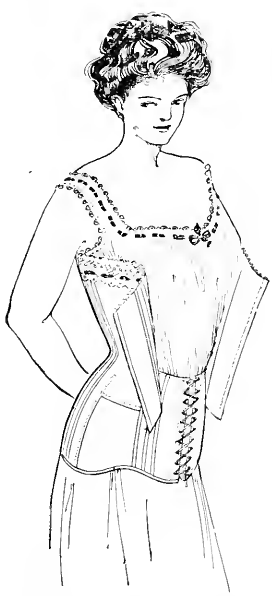


Fig. 304.—Adjusting Upper Segment of Combined Abdominal Supporter and Corset.

Women patients frequently object to the increase of bulk about the lower abdomen when the supporter is worn. In these cases a corset fashioned in the manner shown in Fig. 302 may be advantageously employed. Of course, the prevailing fashion with regard to general effect from an artistic viewpoint must needs be disregarded. The illustration shows a combined supporter and corset arranged in two pieces which are laced separately. The lower segment is applied while the patient is in the position shown in Fig. 303, and the upper portion may be adjusted later, as shown in Fig. 304. The latter step may possibly be sufficiently, readily modified to produce certain artistic effects so dear to the feminine heart. In a general way, the patient should be admonished not to draw the upper segment so tightly as to force the viscera downward and thus, perchance, lessen the efficiency of the lower one.

CHAPTER XXIV

OPERATIONS ON THE ABDOMEN *(Continued)*

OPERATIONS ON THE STOMACH

Gastrostomy—Gastroenterostomy: Hemorrhage; Regurgitant vomiting; Intestinal obstruction; Ulcer of the jejunum; Diarrhea—Gastrectomy, etc.

GASTROSTOMY

Gastrostomy is usually done at a time when the patient's general condition has already suffered to a considerable extent as the outcome of lack of nourishment. It is necessary to partake of liquid food in large quantities to maintain not alone life itself, but to furnish the system with resistance. It is a fortunate circumstance that the operation itself is not attended with much shock, and that the exhaustion following it is not great. However, ample provision should be made to obviate shock which may occur during or immediately subsequent to the operation.

When the patient is about to be operated upon an effort should be made to sterilize the stomach by the administration of sterile food, as already discussed (page 430). Gastric lavage is not readily executed, for obvious reasons. An attempt, however, should be made to accomplish it by means of a stomach tube of narrow caliber. Passing of the tube should be carefully executed, as any trauma to the seat of esophageal obstruction will render subsequent infection of the stomach wound more likely. Immediately before the operation and subsequent to the last cleansing, enema, a nutritive enema of peptonized milk (cold process), should be given. Severe manipulations in the region of the anus should be avoided, as it may be necessary to nourish the patient by the rectum for several days following the operation, and this may be seriously interfered with if the anus be irritated. The existence of persistent cough is an objectionable complication, and should be controlled if feasible before the operation. It is easy to see how coughing would interfere with union of the stomach with the anterior abdominal wall. If cough be present and the operation be not imperatively indicated, a slight postponement of it is wise; if, however, the condition of the patient do not warrant the delay, it may be necessary to administer suf-

Fig. 305.—Tube Leading into Stomach Following Gastrostomy Held in Place.

ficient opiate immediately after the operation to control the symptom, and this may have to be maintained for several days. It is, of course, not a desirable indulgence, but is in some cases the lesser of the evils.

The operative technic most commonly employed at this writing contemplates the formation of a valvular opening into the stomach, this viscus itself furnishing the valve. The wound is quite closed, except for the point of exit of the rubber tube to be subsequently used for the purpose of introducing food, the usual protective dressing is applied, the tube, which should be 12 to 16 inches in length, is led out through the dressing, and after being clamped at its distal end is held in place with a safety pin (Fig. 305). The feeding is done through the tube without disturbing the dressing, which latter is, if there be no indication to the contrary, not disturbed until the eighth or tenth day. How soon food is to be administered is a question of some importance. In a general way, it may be said that it is best not to administer any nourishment by the fistula for twenty-four to forty-eight hours, though if there be no nausea and the patient's general condition has been poor for a considerable period of time,

Fig. 306.—Introduction of Liquid Nourishment through Gastric Fistula.

small quantities of sterile milk, diluted 50 per cent., may be injected through the tube into the stomach. In most cases rectal alimentation will meet the indications for forty-eight hours following the operation, and at the end of this time the introduction of food into the stomach may begin. At first only small quantities of liquid food (2 to 4 oz.) should be introduced, and for the first six days subsequent to the operation this should be sterilized (page 430). After this time the food need not be sterile. Nourishment is introduced by means of a small glass funnel which is readily connected with the end of the rubber tube (Fig. 306). It will be found convenient to use a rubber tube with a flared distal end, such as is used for irrigating catheters in lavage of the bladder. After repair of the wound takes place, it will be found irksome to the patient to constantly wear the tube. It is not wise to let the serous surface with which the valvular folds of the stomach fistula is lined to lie in contact with each other, as they have a tendency to contract.

If this happen, it will be found that irrigation into the external opening with a sterile saline solution will reëstablish the lumen of the canal. However, it is advisable to have left in the opening some dilating apparatus at all times. Fig. 307 shows a plug made of soft rubber and furnished with a shield. The latter prevents the little instrument from slipping into the stomach. The apparatus should be about three inches in length and be conical at its intragastric end to obviate irritation. The writer has had a patient wear this apparatus for eighteen months following a *Senn* gastrostomy with satisfaction to the patient.

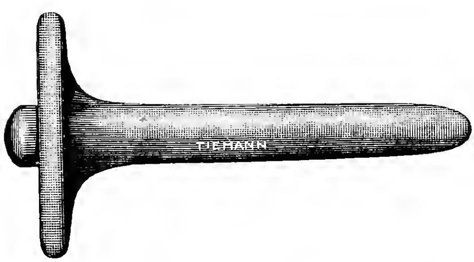


Fig. 307.—Soft Rubber Obturator to be Worn in Gastric Fistula between Feedings.

Gastric feeding soon relieves the distressing thirst from which these patients suffer, and they almost invariably gain weight, even though the gastrostomy have been done for malignant disease of the esophagus. In instances in which the esophageal obstruction is due to impermeable cicatricial contraction, or to pressure from aneurism, the gain in weight is very marked.

In nourishing the patient, an important factor is that of the mental state the patient develops after a time as the outcome of the necessity of feeding himself by a tube and, while the saliva is not essential to digestion, the act of mastication undoubtedly has an influence upon nutrition in this much, that appetite is stimulated by the act. Patients suffering from esophageal obstruction who have been subjected to gastrostomy may be said to be hungry but devoid of appetite. It is well to permit the patient to thoroughly masticate small particles of ordinary articles of diet and expectorate the mass in small quantities into the funnel from which it can be washed into the stomach by the addition of liquids. In the event of the tube becoming obstructed by the particles of food, the funnel may be disconnected and a syringe (Fig. 251) filled with boullion inserted and the semi-solid mass forced into the stomach. The writer has found that no preparation on the market for the purpose of nourishment will take the place of meat fiber. A means of introducing this into the stomach has already been taken up in connection with sterile diet. However, for the purpose of feeding a patient who has a gastric fistula, a pound of lean beef is mangled and shaken up with cold water. This need not be heated for the purpose, but is sucked into the syringe (Fig. 251) and forced into the stomach (Fig. 308). Cooking meat does not increase its digestive characteristics; indeed, it lessens it and the measure suggested may be advantageously employed once a day or three times a week. Indeed, the patient will improve most rapidly if the physiology of digestion be borne in mind, and the introduction of food be based on the well-known fact that man is essentially on omnivorous animal, and he be treated accordingly. Radical and peculiar views in this connection should be combated.

The fats are, of course, readily administered, as their consistence is only a question of temperature. It is true that the fat contained in milk is in the form of an exceedingly fine emulsion, and in a condition favorable to ready digestion. However, it will contribute not a little to the patient's conception of his status if fats be introduced in other forms. For the purpose, an ounce or two of butter slightly warmed to render it readily introduced, may be forced through the tube into the stomach at intervals. A fatty soup, while not palatable, may be injected, and the " gravy " of roast meat may be fed to the patient in a similar way. The carbohydrates are, of course, soluble in water, and present no difficulty with respect to administration. The use of the constituents of the classes mentioned will obviate the necessity of too frequent feedings, for it is to be remembered that physiologically digestion is an intermittent process, and this fact should be conserved in feeding patients subjected to gastrostomy.

During the intervals between feedings the plug shown above (Fig. 307) is worn, and the wound is cleansed with a mild solu-

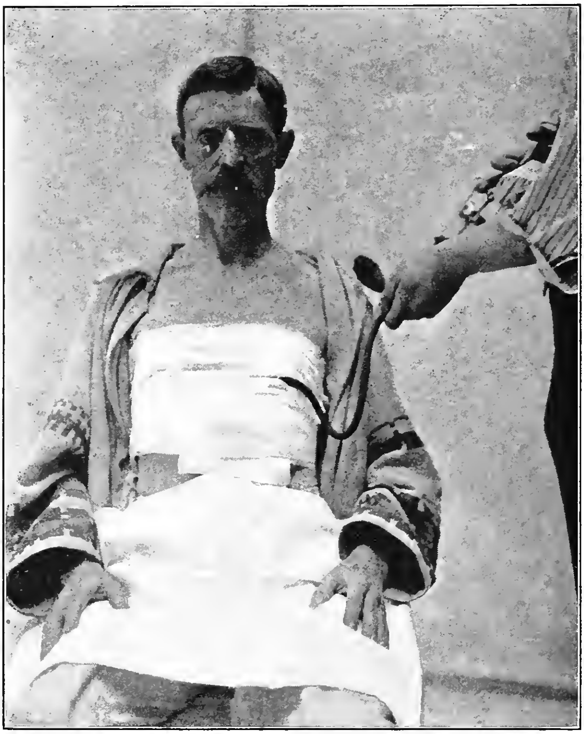


FIG. 308.—FORCING MACERATED BEEF INTO STOMACH THROUGH GASTRIC FISTULA BY MEANS OF SYRINGE.

tion of carbolic acid or simple sterile water immediately before and after feeding. The patient should be furnished with several feeding tubes, and these should be kept clean. The character of the stools should be subjected to examination at intervals with the view of determining which of the articles of diet are not completely digested. A record of the patient's weight is a useful index as to the nutritive value of the food administered.

GASTROENTEROSTOMY

Gastroenterostomy should be prepared for by an attempt at sterilization of the gastric mucosa. This is more readily attained than sterility of the intestinal lumen for the reasons above stated (page 424). In all instances systematic gastric lavage should be practiced for some time (several days) before the operation. The operation is performed for the purpose of draining the stomach,

Fig. 309.—*Moynihan* Position after Gastric Operations.

and the conditions which provoke stasis in this organ also permit of the decomposition of food, and a certain amount and degree of gastric inflammation always coexists. This is attended with a coating of the gastric mucosa with a thick, tenacious mucus secretion which is difficult to remove and which, if left *in situ,* presents exceedingly favorable conditions for infection. The gastric lavage had best be done by means of solutions which will dissolve the mucous coating, thus rendering the efforts at sterilization of the interior of the organ more readily executed. A teaspoonful of sodium bicarbonate to the quart of sterile water or a teaspoonful of magnesium sulphate to the quart of sterile water are efficacious agents for the purpose. The use of antiseptic solutions of sufficient strength to be efficacious are dangerous, and should not be used. The administration of isoform is justifiable and of service. The diet for several days preceding the operation should consist of organic nitrogenized substances (sterilized, page 430), and fats and carbohydrates are to be avoided, as the latter are not digested in the stomach and only complicate the problem.

Lavage of the stomach with considerable quantities of sterile cleansing solution immediately before the operation, when the patient is in the anteroom and under narcosis, is a measure which gives additional security to the operative procedure with respect to the avoidance of infection.

Immediately after patient regains consciousness following gastroenterostomy, he should be postured in the sitting position (Fig. 309), with the idea of facilitating drainage of the stomach. The accumulation of secretions, the outcome of a certain amount of atony of the stomach, due to handling together with the overdilatation, the result of the affliction for which the operation is performed, renders the emptying of the stomach a difficult problem and the supine position may permit of collections in the organ. This will be, in a measure, obviated by posturing the patient as stated. The complications following the operation may be stated as follows:

HEMORRHAGE

Hemorrhage is of significance in proportion to its amount. A slight bleeding always results from the oozing of the edges of the wound and blood, more or less changed in character and appearance as the result of the action of the gastric digestion, appears in the vomitus in most instances. This need not be regarded as significant, however, if unattended with other symptoms. Bleeding itself is rarely fatal, though fatal cases from this cause have been reported. Unless due to some defect in technic (failure to deligate the bleeding points), the appearance of blood in the vomitus in considerable quantity suggests acute dilatation of the stomach, a condition which from the nature of the affliction for which the case is subjected to operative attack, is an exceedingly likely occurrence.

Hemorrhage *per se* will give the characteristic symptoms of loss of blood in contradistinction to the clinical picture already described under acute dilatation of the stomach (page 277). Measures of relief should be directed toward arrest of the hemorrhage. It is doubtful if a secondary operation, exposure of the bleeding point or points and ligature of them will be recovered from. However, it is wisest that it should be undertaken before too much time has been expended in futile efforts to control the hemorrhage by the introduction of hemostatics into the stomach.

A moderate amount of bleeding with persistent vomiting and no particularly striking symptoms of loss of blood justifies lavage of the stomach, and if, at the end of several hours a second lavage again reveals the presence of accumulation of blood in the stomach, and at the same time pallor, acceleration of pulserate and inordinate thirst are manifest, a secondary celiotomy should be undertaken without delay, as giving the patient the best opportunity for recovery.

REGURGITANT VOMITING

Regurgitant vomiting, a common, fatal complication, has been made the subject of considerable study. The mechanical causes relate to the method of technic of the operation, *i.e.,* the method of anastomosis. A discussion along these lines does not belong here. In a general way it may be said, in this connection, that the employment of the more modern methods of anastomosis (the posterior) has made this distressing, and often unsurmountable postoperative complication a less frequent occurrence than previously obtained. It is also proper to state here that the influx into the stomach of bile and pancreatic juice of themselves is no longer regarded as a causative factor in the problem. The latter point has been quite definitely settled in an experimental way on the lower animals, and *Moynihan* reports a case of complete rupture of the gut at the duodenojejunal junction, in which he closed by suture the torn end of the duodenum and joined the jejunum to the stomach. All the bile and pancreatic juice flowed into the stomach without any unfavorable occurrence as the result. If regurgitant vomiting persist, it is fair to assume that a mechanical cause exists which is only remediable by secondary operation, and this should not be postponed until the patient's condition becomes menacingly enfeebled. The operative relief is, of course, not properly discussed here. This does not mean, however, that a moderate regurgitation should be looked upon with great apprehension and, indeed, it is astonishing how readily a certain number of cases of this sort clear up under copious gastric lavage. The lavage need only be employed once in twenty-four hours to achieve relief. It may be said that if regurgitant vomit recur within a few hours after the primary lavage, the case should be subjected to careful scrutiny with the view of promptly employing operative measures of relief. In the majority of instances it will be found that the cause of the disturbance lies in there having been left too long a loop of jejunum between its beginning and the site of the anastomosis.

INTESTINAL OBSTRUCTION

Intestinal obstruction from mechanical causes follows in a certain number of cases. It is quite easy to realize how the kinking and snarling of the gut as the outcome of normal structures, abnormally placed, may occur sequentially to an operation, involving opening of the transverse mesocolon or displacement of the omentum. These cases differ in causation from those presented in intestinal paresis or paralysis due to abolition of enervation. The latter are at times amendable to non-operative treatment; the former are fatal unless relief is afforded by operation.

The clinical picture of mechanical intestinal obstruction following gastrointestinal anastomosis does not differ from that due to other causes. The differential diagnosis between it and intestinal paralysis rests most upon the absence of pain in the latter instance, and the fact that intestinal paralysis is quite continuous with the immediate postoperative symptomatology, while obstruction does not occur for several days after the operation.

ULCER OF THE JEJUNUM

Ulcer of the jejunum after gastroenterostomy has the same etiological factors as obtain with duodenal ulcer. It is consequential to the operation, inasmuch as the ulcer occurs in the jejunum. Its occurrence is heralded by disturbances of digestion, pain and vomiting, as is ulcer of the duodenum. Its possible occurrence should be borne in mind during the postoperative treatment, with the view of affording operative measures of relief.

DIARRHEA

Diarrhea occurs in a small number of cases. It is rarely fatal, though fatal occurrences have been reported. The cause of the diarrhea has not been satisfactorily explained. The theory that the entrance of abnormal amounts of acid secretion from the stomach into the intestine, before being subjected to the immediate neutralizing effect of the bile and pancreatic juice, is not accepted on the ground that marked hyperchlorhydria has not been observed in the cases afflicted with the malady. Attention to diet, as subsequently advised, the administration of opiates, isoform, naphthol, and colic lavage relieves very soon the symptoms in the majority of instances.

GASTRECTOMY, ETC.

The complications enumerated above are all likely to occur after gastrectomy, plastic operations for hour-glass contraction of the stomach, excision of ulcers, and, indeed, any operative attack upon the stomach and may be regarded as indicative of the problems encountered after each one of the operations mentioned. Gastrostomy permits of introduction of food into the stomach, which requires considerable exercise of its digestive functions soon after the operation, because in this class of cases leakage is not liable to occur, and the stomach itself has not been the seat of affliction impairing its functions. It would seem proper, therefore, to discuss more extensively the question of postoperative administration of food at this time.

The introduction of food into the stomach after operations invading its lumen should be avoided for five days, if this be feasible, and the patient fed by the rectum (page 291). The explanation of the apparent inconsistency of this advice, and the recommendation that copious gastric lavage immediately subsequent or soon after the operation is justifiable, lies in the fact that the lavage is attended with muscular effort on part of the stomach only as the lavage is made, and that the cleansing fluid is entirely withdrawn, leaving the stomach empty. On the other hand, the effort at digestion following the administration of nutritive substances provokes an irregular contraction of the stomach which is prolonged over a considerable period of time, and disturbance of the line of union may occur in consequence. It is frequently noticed that distention of the approximated portions of gut and stomach does not result in leakage of gas at the time of the operation, and the anastomosis is regarded as "tight." This is about the condition of affairs which obtain during cleansing lavage, and differs quite radically from those which attend the movements of the stomach during digestion.

It is true that union of apposed peritoneal surfaces takes place at the end of twenty-four to thirty-six hours. However, the union is not sufficiently firm at the end of this time to warrant taking unnecessary risks. This does not mean that small quantities of water may not be partaken of at intervals at the end of twenty-four hours following the operation, but it is certainly best to omit the introduction of fluids containing substances requiring the exercise of the digestive function at an earlier time than here mentioned, provided the conditions will warrant. It also does not mean that, if diarrhea, or irritation of the rectum be dominant factors, small amounts of liquid food might not be taken by the patient on the fourth day after the operation. Yet, on general principles the patient should be nourished by rectum for five days after the operation, if this be at all possible.

At the end of this time peptonized milk in small doses, frequently repeated, soups, boullion, indeed liquids of any kind may be given. The chief reliance as far as nutrition is concerned may be placed in the milk and its products. Eggs, raw or slightly coagulated, may be given on the seventh day. Solid food should not be allowed for twelve days and, indeed, had best not be taken until at the end of two weeks after the operation.

All substances introduced into the stomach for a week following the operation should be sterile (page 430). Of course this applies also to cleansing fluids. While healing of the apposed serous surfaces undoubtedly has taken place at the end of the five days, the same does not obtain with regard to the mucosa and, indeed, when the technic of the anastomosis is borne in mind—how firmly the through and through stitching is made—it is easy to conceive that more or less necrosis of the tissues along the line of suturing is probable. This raw surface should not be unnecessarily exposed to infection. The gastric secretion is only markedly acid during digestion, being neutral or alkaline in the intervals. The avoidance of nourishment by mouth for the time mentioned may obviate the maceration of the mucosa, which would result from contact with the acid juice while repair is going on. All of this can, of course, not be avoided, either by abstinence from food or by the subsequent sterilization of the ingesta. However, the dangers in this connection are certainly lessened by careful observance of the suggestions offered. The care and treatment of the superficial wound does not differ from that of celiotomy made for other reasons (page 448). The wearing of a supporter after operations on the stomach is not indicated, unless, as is at times necessary in stout individuals, the abdominal section is carried below the umbilicus, or if extensive infection of the wound has taken place, with sloughing and loss of substance. In the latter contingency, an abdominal supporter, as described (page 475), made somewhat wider and devoid of the perineal straps, may be worn as a precautionary measure, if the patient be engaged in an occupation requiring the exercise of great muscular effort. In women the corset (page 480) will be found to answer the purpose very well.

CHAPTER XXV

OPERATIONS ON THE ABDOMEN (*Continued*)

OPERATIONS ON THE INTESTINES

Enterectomy, etc.: The Diet; Catharsis; Fecal fistula—Appendectomy—Appendicostomy—Colostomy: Colostomy pad—Colectomy.

ENTERECTOMY, ETC.

Enterectomy, enteroanastomosis of the small intestine, and, indeed, operations contemplating opening of the lumen of the gut, call for the same local and general preparation taken up under celiotomy and sterile diet, etc. A repetition of these measures is superfluous. It is probable that comparative sterility of the small gut requires for its achievement a longer period of time than obtains with respect to the stomach. This time is not available in all instances. However, if the operative procedure is not urgently indicated, five or six days of preparation along the lines laid down above is desirable.

The use of mechanical devices to facilitate anastomosis, such as the *Murphy* button and the like, has been quite abandoned. However, unless the surgeon have some experience in sewing gut, it is well to have available at the time of the operation a "*Murphy* button" or similar instrument to conserve speed in operating. Again, it at times happens that the general condition of the patient becomes alarming during the operation, the outcome of shock, and if the operation need be rapidly completed, recourse to these aids is justified, even though they are less accurate in their accomplishments than is desirable.

When the operation is undertaken for the relief of acute obstruction, delay is, of course, objectionable, and the preparation of the patient as far as the cleansing of the intestinal lumen is concerned, must be restricted to gastric lavage and cleansing of the colon by enema. The former must under no circumstances be neglected for the reasons taken up under the head of sterilizing the digestive tract. The after-treatment in this class of cases differs only from that of celiotomy generally, inasmuch as the patient is kept in the dorsal position, unless for especial reasons the semi-sitting posture is indicated (page 457).

THE DIET

The diet following operations on the small intestine should be sterile for several days after the introduction of food by mouth is begun. The time of beginning gastric feeding is not necessarily as long after the operation as is permitted to elapse following attack upon the stomach. In a general way, it may be said that the lower down, nearer the anus the operation is, the sooner may gastric alimentation begin. However, no food should be given by mouth for forty-eight hours after the operation in any event. In the meantime, the patient is nourished and stimulated by the lower bowel. Thirst, this exceedingly distressing symptom following all operations involving the intestinal tract, may be more readily relieved in this class of cases by supplementing the colic irrigation with small doses of hot water given by mouth within twenty-four hours after the postoperative vomiting has ceased.

CATHARSIS

Catharsis is a problem which in these cases presents some difficulties. From the viewpoint of the histology of wound repair, the intestine should be kept quiet for several days following the operation to conserve repair. However, the administration of agents destined to inhibit peristalsis favor intestinal paralysis, and this is a serious complication. The attendant must take all the factors into consideration.

Certain it is that no cathartic should be administered after the lumen of the gut has been invaded for three days after the operation, and then only if a special indication for its employment presents. It is difficult to see just what this indication may be, however, if eserin and belladonna stimulate peristalsis, they may be regarded as cathartics and, indeed, act as such; if symptoms of intestinal paralysis develop they do not, as a rule, constitute a menacing factor for twenty-four hours or more subsequent to the operation, and their administration should be withheld for at least this period of time. Indeed, the writer does not administer cathartics to cases of intestinal surgery for ten days following the operation, employing a sterile diet for five days and daily cleansing of the lower bowel by enema, until normal defecation takes place, or until sufficient time has elapsed to make safe the use of cathartics. The postoperative complications following enteroanastomosis are in all respects similar to those discussed under gastroenterostomy (page 488), and are met in the same way.

FECAL FISTULA

Fecal fistula may be mentioned in this connection as occurring in a certain number of cases. This, of course, means infection of the superficial wound and requires drainage (page 185). When a fecal fistula occurs, the wound must be cleansed daily and the skin surrounding it covered with an ointment containing some antiseptic, like iodoform or aristol, to obviate irritation of the skin in the neighborhood of the wound, the result of the discharge. Fecal fistula frequently heals spontaneously, and this need not be despaired of even at the end of several weeks following the operation. The care of the superficial wound, removal of stitches, the after care with regard to hernia, etc., are all taken up under the general head of celiotomy (page 433, *et seq.*).

APPENDECTOMY

Appendectomy is frequently an emergency operation. In the emergency cases the preparatory measures described above are of necessity modified to meet the special indications. When appendectomy is done in the intervals between attacks, the preparation for the operation is in all respects similar to that for intestinal surgery.

Interval appendectomy, being usually made through an intermuscular incision, requires perhaps less prolonged confinement in the dorsal position than is necessary when the approach it attended with division of the muscular fibers. However, the attendant is warned not to be hasty in this regard. Patients who have suffered from a mild appendicitis, and who are willing to have the appendix vermiformis removed as a precautionary measure, are in a measure influenced in their willingness to be operated upon by the consideration that only five or six days of confinement and ten days' absence from the usual occupation will be required. This is not a wise procedure. Indeed, even after an intermuscular appendectomy the patient should not be permitted to leave the sick room for ten days, and prolonged muscular effort should be refrained from for two weeks.

Of course, if infection of the superficial wound occur as a complication during the postoperative period, the patient should not be permitted to exert the abdominal muscles until repair of the wound in the muscle and aponeurosis of the external oblique has taken place. If the appendectomy or approach to the site of the appendix with abscess is made and subsequent drainage is introduced, the confinement to bed should be maintained until repair is quite complete. Fecal fistula follows quite frequently the ablation of the appendix when the inflammatory process involves the portion contiguous to the base of the appendix. These fistulæ usually heal spontaneously, unless the infection is tuberculous, and the care of the wound is in all respects similar to that of infected wounds elsewhere (page 305), with the exception that drainage of the wound should be provided for, and packing introduced only in portions of the wound to either side of the canal leading to the opening in the gut. If the packing interfere with free egress of the feces, the latter will at times infiltrate the tissues between the muscles, giving rise to cellulitis of considerable magnitude, and necessitating the making of additional drainage openings. The dressing should be changed daily or, in the event of free discharge of feces, twice daily. The introduction into the fistulous tract, if it persist after the major portion of the wound is repaired, of tincture of iodin is a serviceable measure.

The patient should be kept quiet until healing is quite accomplished, although, when only a small fistulous tract exists, he may be permitted to go about with a firm abdominal supporter (page 475) placed over the protective dressing. Cases which have been subjected to intermuscular appendectomy and in which primary union has been attained need not wear an abdominal supporter. However, it will be best to furnish those cases in which drainage has been employed with a bandage, which should be worn for three months after the operation. The postoperative complications following appendectomy are in all respects similar to those taken up under gastroenterostomy.

APPENDICOSTOMY

Appendicostomy executed by the intermuscular method renders infection of the peritoneal sac during the healing process quite unlikely. Some surgeons after developing the fact that the appendix is patent, deligate it near its point of emersion from the abdomen and permit the extra-abdominal portion to slough off.

This measure is less apt to result in infection than the introduction of a rubber tube while the isolating adhesions are being formed. If the tube is used it is clamped, but is not brought out through the dressing, as lavage of the colon is not practiced until sufficient repair has taken place to obviate the danger of leakage of the cleansing fluid into the peritoneal sac. The primary lavage should not be undertaken for five days after the operation. The dressing need not be changed during this period of time, unless some special indication for doing so appear.

There is no leakage of feces from the lumen of the appendix after the operation, its entrance appearing as a small dimple, which at times secretes a small quantity of serous fluid. For this reason the patient should wear a square of gauze, several layers in thickness, fastened to the portion of undergarment contiguous to the opening. When improvement of the condition for which the appendicostomy is done becomes manifest, the irrigations are, of course, less frequently made. If an interval of more than five days between injections is regarded as advisable, the patient must be instructed to pass into the canal a glass rod or the handle of a steel nasal applicator or similar device, at the end of the third day after the last lavage, in order to assure patency of the communication with the cecum. The appendicostomy opening has been known to heal in six days, and as the chronic inflammatory process, for the relief of which the treatment is employed, is exceedingly liable to recur for a period of years, it is best to obviate the possibility of closure of the opening in the manner stated for this period of time.

The technic of the colic lavage is exceedingly simple. The water receptacle is raised to about four feet above the wound, and the distal end of the connecting tube furnished with a wide, straight eye-dropper which is readily passed into the canal. The temperature of the lavaging fluid should be about 105° F.

The solutions employed vary, of course, with the character of the affliction from which relief is attempted. It is not improbable that mechanical cleansing is the most effective factor in the treatment, and this may be achieved by normal saline solution, the salt being added to sterile water, with the view of obviating the extraction of inorganics from the colic mucosa consequent to the use of water alone.

Patients past forty years of life should wear a light abdominal supporter to obviate the chances of a ventral hernia. The danger in this regard is not great. However, it is exceedingly exasperating to have a portion of the cecum push its way out through the opening in the muscles. The gauze pad spoken of may be affixed to the inner side of the supporter. This is quite essential, for the supporters are not readily cleansed, and when stained with secretion are liable to become offensive.

COLOSTOMY

Colostomy, being undertaken for relief of obstruction, is prepared for in respect to direct cleansing of the colon with difficulty. For obvious reasons, however, an attempt at irrigation of the colon for several days with a solution of acetozone fifteen grains to the quart should be made. It is not infrequently feasible to pass through the stricture from below a rubber tube of small caliber and effect gradually a comparative cleansing of the colon. For the purpose the patient should be placed in the *Sims* lateral position (Fig. 346), with the hips elevated or in the knee-chest posture. Great gentleness in manipulations should be exercised in the attempt, as the portion of colon above the obstruction is likely to be quite thin and perchance ulcerated from pressure. Then, too, large quantities of fluid should not be allowed to flow into the gut for the same reason. It is at times wise to precede the colic lavage by gently injecting beyond the obstruction four or six ounces of sterile olive oil, which will soften hardened portions of feces, and this may be followed by the careful introduction of a solution of sodium carbonate $\frac{1}{2}$ per cent. with the view of saponifying the mixture of oil and feces, thus facilitating discharge of the contents of the bowel through the stricture. The precautions with respect to sterile diet should be taken. The administration of cathartics should aim at liquid stools for a considerable period of time preceding the operation. A more or less empty colon at the time of the operation facilitates much the surgical technic and should be attained if possible.

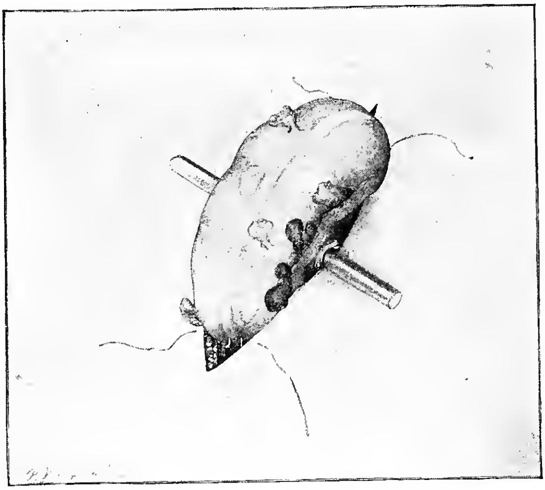


Fig. 310.—First Step of Colostomy. Appearance of Wound. (*Tuttle.*)

Colostomy is almost always done in two stages, unless the indications call for immediate relief of obstruction. In the latter instance the wound is treated in the same way as a fecal fistula (page 496). When the intact colon is brought into the wound and fastened in place, the immediate treatment is that of a clean wound. The colon is usually held in place by a glass rod or a supporting stitch, and the colon is sectioned on the fourth day after the primary operation.

Fig. 310 shows the appearance of the wound and colon when the first stage of the operation is completed, except for tying of the sutures in the superficial wound which holds the distal portions of the extra-abdominal portion of the colon in place.

During this time the bowel is kept quiet by the administration of $\frac{1}{4}$ grain of morphia given under the skin. The dose should be repeated in twelve hours and usually need not be again repeated.

At the end of four days the peritoneal healing will have sufficiently progressed to render infection of that membrane very improbable. However, the superficial wound will not be healed by this time, and great cleanliness and careful drainage of the wound should be maintained to prevent burrowing of infective secretions. The surrounding skin should be covered with an antiseptic ointment. The retaining glass rod or supporting

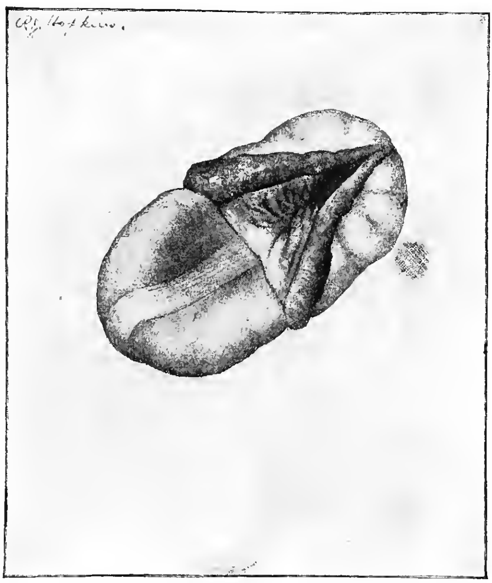


FIG. 311.—INCISION OF PROTRUDING GUT IN COLOSTOMY. (*Tuttle.*)

stitch need not be removed for eight days after the operation. The segment of gut below the colostomy should be irrigated daily with a saline solution.

At the end of four days after the primary operation the gut is sectioned. For the purpose *Tuttle* advises that the colon be divided across at the center of the protruding portion and then sectioned in a longitudinal direction (Fig. 311). By this means the upper triangular flaps roll backward and dry up. The straight lower flap of the lower segment of gut falls downward and inward, practically closing the opening. The fecal discharges are thus carried outside of the abdominal cavity, and there is scarcely any possibility of their gaining access to the lower bowel.

COLOSTOMY PAD

After convalescence is established, the patient wears a pad of soft rubber held in place by an elastic band running about the body (Fig. 312). The pad is slipped into a steel ring which per-

FIG. 312.—COLOSTOMY PAD HELD IN PLACE OVER ARTIFICIAL ANUS.

mits of easy removal of the pad. This permits of interchange at frequent intervals of a second similar pad which is kept on hand. The feces are received in a receptacle fashioned to fit the body (Fig. 313). The pad is removed twice daily, the feces re-

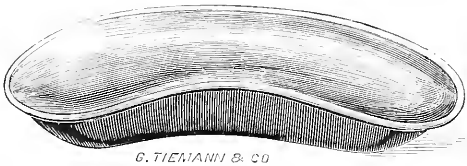


Fig. 313.—Receptacle Suitable for Receiving Feces from Colostomy Opening.

ceived in the receptacle (Fig. 314), and the colon cleansed by injecting saline solution into the upper opening (Fig. 315). The

Fig. 314.—Emptying Colon into Receptacle.

lower portion of the bowel, that distant to the fistula, is cleansed at frequent intervals.

FIG. 315.—CLEANSING COLON THROUGH COLOSTOMY OPENING.

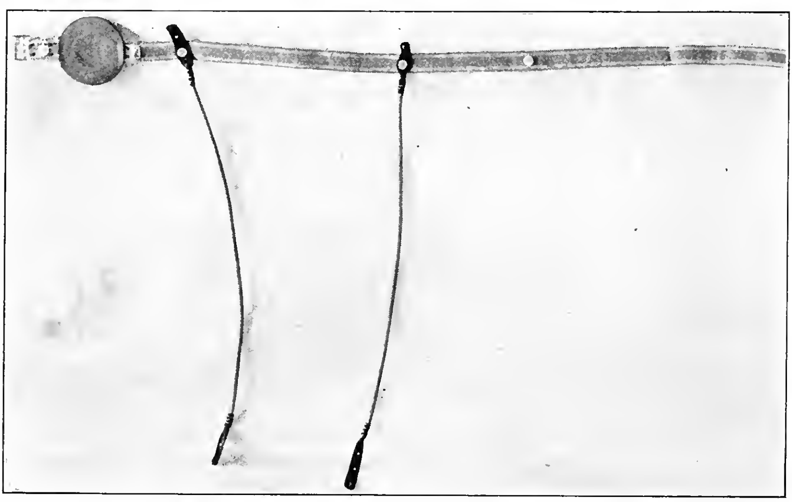


FIG. 316.—COLOSTOMY PAD WITH ABDOMINAL BELT AND PERINEAL STRAPS. THE STRAPS ARE FASTENED TO THE BUTTONS ON THE BELT.

The pad is affixed to a band which goes about the body, the latter being held down by two perineal bands furnished with buttonholes to allow of modification as to tension. Fig. 316 shows the apparatus complete, Fig. 317 shows the pad removed

Fig. 317.—Colostomy Pad and Ring. Pad Shown from Side Turned toward Fistula when Worn.

and turned with the side that goes over the colostomy opening turned out. The cuts show the facility with which the pad may be removed.

COLECTOMY

Colectomy when followed by anastomosis of the sectioned colon and closure of the abdominal wound does not call for especial consideration beyond those taken up under abdominal surgery and colotomy. It is well to bear in mind that the colon does not heal with the same rapidity as the small intestine after

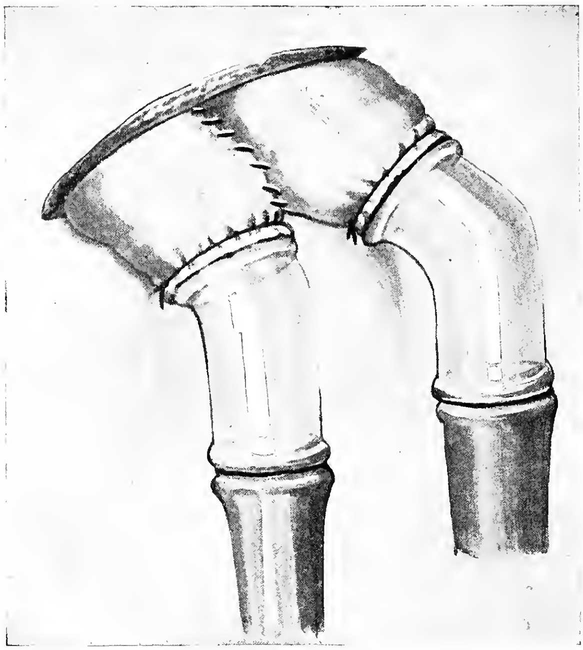


Fig. 318.—*Paul* Tubes *in situ* Connected with Rubber Tubes for Drainage of Contents of Colon. (*Moynihan.*)

section, and also that colic lavage immediately following the operation must be avoided, for fear that the line of union may be ruptured.

Fig. 319.—*Paul's* Tube. Showing Flanges for Drainage Tubes. (*Moynihan.*)

Colectomy and temporary colostomy is a procedure which has been largely employed within recent years. The method unites laterally the ends of the colic lumen and drains both the proximal and distal portions of the gut. Fig. 318 shows the operation completed. The *Paul* tubes (Fig. 319) afford excellent drainage, and if they are, as shown in the illustration (Fig. 318), connected with rubber tubes of large caliber, the wound is not contaminated by the discharges from the gut. The rubber tubes are led into a suitable receptacle fastened to the side of the bed, the receptacle being partially filled with a solution of corrosive sublimate, 1 in 1,000, or other antiseptic. There is no odor, and the protective dressing need not be changed until the usual time, governed by the rules laid-down under celiotomy. When the time arrives for reëstablishment of the continuity of the canal the wound will be found clean, an advantage of some importance.

CHAPTER XXVI

OPERATIONS ON THE ABDOMEN (*Continued*)

OPERATIONS ON LIVER AND FEMALE PELVIC ORGANS

Hydatid cysts of liver—Hepatic abscess—Resection of liver—Operations on gall-bladder and biliary passages — Cholecystotomy — Cholecystectomy— Hepaticostomy, choledocotomy, chole and cholecystenterostomy: Biliary fistula—Transperitoneal operations on the uterus and adnexa.

The general preparation of patients about to be subjected to operative attack upon the liver should take into account the considerations taken up under jaundice, and its coexisting lessening of the coagulability of the blood (page 21). Operations on the liver are likely to be attended with severe bleeding, because of the intimate association of the parenchyma with the walls of the veins, and provision should be made to meet the indications in this regard. The actual cautery should be available, and the assistants should test the same before the operation as to its serviceability, with the view of obviating delay in this connection. Large quantites of normal saline solution, a liberal number of gauze pads, and proper provision for combating shock should be available. The local preparation does not differ from that made for celiotomy (page 422).

HYDATID CYSTS OF LIVER

Hydatid cysts are usually drained after the contents have been evacuated. In some instances tube drainage is employed, but in the majority of instances the cyst cavity is drained with gauze. In a certain number of cases a *Mikulicz* tampon (page 268) is introduced which is removed at the end of twenty-four hours and a gauze or tube-drain is placed into the inferior angle of the wound, after which the incision in the abdominal wall is closed in the usual manner. The shortening of the drain and its ultimate removal is governed by the same rules laid down in connection with drainage, discussed under that head (page 186).

As a rule, unless infection has complicated the cyst before the operation, there is little discharge from the wound, and it is not improbable that subsequent purulent discharges are the outcome of infection, the result of postoperative manipulations. For this reason, though moderate infection is attended with little danger under the circumstances, care should be taken in changing the dressing to obviate this contingency. It is also to be remembered that infection is more likely to predispose to the occurrence of ventral hernia, although hernia in this situation is not common, for obvious reasons.

Especial measures with respect to the postoperative care of the wound relate to the possibility of grafting of hydatid cysts, as the outcome of contact of the contents of the sac with the surfaces contiguous to the wound. It is not always possible to be certain that no minor residuum of cyst contents remains behind, and this may contain the causative parasite. For this reason, cleansing of the wound during the postoperative treatment should be made with corrosive sublimate solution or other antiseptic, in preference to the use of saline solution or sterile water for the purpose. The use of hydrogen peroxid is permissible when the tampon is being removed, or for the purpose of cleansing the cyst cavity immediately after its removal, *i.e.,* when ready egress of the fluid is provided for. After the superficial wound is closed to its greatest extent and simple drainage is introduced, the injection of fluids into the cavity is unwise until it is quite obliterated by granulation tissue.

At times a small cavity persists for a considerable period of time. It is of service, in these instances, to apply to the interior of the cavity tincture of iodin, introduced by means of a cotton pledget wound on an applicator or probe. This measure stimulates healing and destroys what slight infection may have occurred.

HEPATIC ABSCESS

Hepatic abscess is always drained after the pus is evacuated. For the purpose tube-drainage is usually employed until the discharge of pus is very small in quantity, when a cigarette drain or a strip of gauze will meet the indications.

Surgical attack of hepatic abscess does not involve any problems as regards preparation of the patient and subsequent treatment not taken up under celiotomy and drainage after abdominal operations. The dressings should be changed daily for a week following the operation, and thereafter every forty-eight hours will suffice until repair takes place. As adhesion between the liver substance and the anterior abdominal wall are contemplated in the operative procedure, the occurrence of ventral hernia is not likely.

The writer approaches abscess of the liver through a liberal celiotomy wound, packs off the surrounding peritoneum, and after evacuation of the contents tampons the residual cavity with the *Mikulicz* tampon. The packing is quite firmly introduced. At the end of twenty-four hours the tamponade is removed (page 268). At the time of the operation through and through sutures are introduced into the abdominal wound, and these are tied when the tampon is removed. At this dressing a goodly-sized "cigarette drain" (Figs. 154 and 155) is introduced at the inferior angle of the wound. When the discharge of pus lessens silk-worm gut drainage is introduced (Figs. 147 and 148), and this removed strand by strand until the expulsion of inflammatory exudate ceases entirely.

After the first forty-eight hours following the operation, drainage is conserved by posturing the patient in the sitting position, similar to that employed after gastroenterostomy (Fig. 309).

Abscess of the liver may be regarded as most commonly due to infection from the gastrointestinal canal. An effort to obviate the causative condition in the digestive tract should be made as soon as the immediate postoperative symptoms subside. For the purpose the administration of intestinal antiseptics and the use of gastric lavage will be found useful.

The diet need not be restricted in the manner usually employed following celiotomy for invasion of the digestive tract. However, the precautions with respect to postoperative vomiting should be observed, as the straining of the abdominal muscles coincident to the act of vomiting interferes with the prompt formation of adhesions between the sectioned liver and the abdominal wall. The movements of the diaphragm, also, should be controlled as far as feasible with the view of aiding in the formation of adhesions in this situation. For this purpose the judicious use of opiates for the twenty-four or forty-eight hours immediately subsequent to the operation will be found a useful measure.

RESECTION OF THE LIVER

Resection of the liver presents no special indications with respect to postoperative care. In most instances the wound in the liver is repaired at once and the abdominal incision closed in its entirety. In rare instances tamponade of the traumatized area of liver is necessary with the view of arresting hemorrhage. In these cases removal of the tampon and subsequent care of the wound is carried out along the lines already laid down. On the whole, the postoperative treatment and operations on the liver are similar to that of celiotomy, and the postoperative complications and their treatment are the same as described under that head.

Peritonitis and intestinal obstruction, either due to paralysis of the gut or to mechanical causes, are less frequent in this class of cases than obtains following either manipulation or section of the intestinal canal. As already stated, the liver moves with respiration, and operations which contemplate adhesion of the surface of the liver to the anterior abdominal wall should be followed by the administration of opiates in sufficient dosage to control the pain consequent upon the strain brought to bear on the sutures introduced with the view of fixing the liver. In instances in which the liver wound is closed and the abdominal section repaired by suture without drainage this need not be considered. However, in the class of cases alluded to, it had best be met in the manner stated.

The tampon introduced for the purpose of arresting oozing of blood must be carefully loosened before removal, with the view of avoiding trauma to the clots obliterating the divided ends of the hepatic vessels, especially the veins. For the purpose the gauze strips introduced into the " umbrella " gauze is thoroughly moistened, and, after their removal, hydrogen peroxid is syringed under the edges of the outer layer of gauze, which will lift it from contact with the surface of the wound. The writer has used a mixture of adrenalin solution, a drachm to a pint of hot saline solution in this manner, with considerable success. Hydrogen peroxid is not readily heated, and the added atom of oxygen is likely to be displaced by application of the degree of heat necessary to act as an hemostatic. Cold peroxid of hydrogen has some

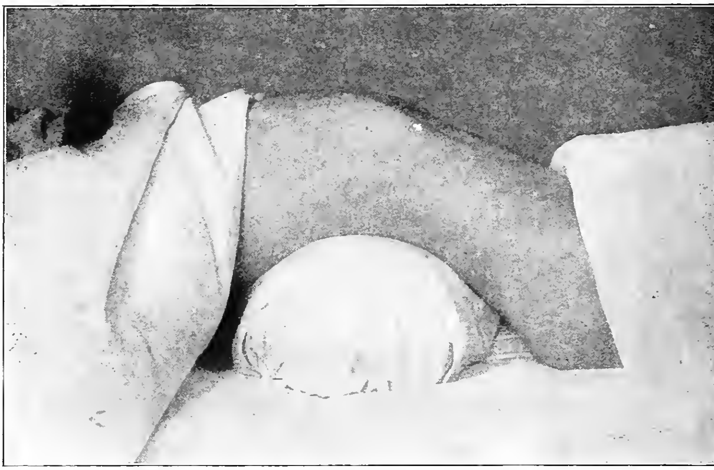


Fig. 320.—Sand Bag in Position for Approach to Biliary Passages. (*Moynihan.*)

hemostatic qualities, but is not as efficient for this purpose as the mixture mentioned.

It is probable that the tamponade should not be left *in situ* for longer than forty-eight hours after the operation. The portion of peritoneum covering the liver is quite in contact with the lower surface of the diaphragm, an anatomical fact which explains the occurrence of hiccough and respiratory difficulties following operations in this situation.

OPERATIONS ON THE GALL-BLADDER AND BILIARY PASSAGES

Access to the gall-bladder and biliary passages is greatly enhanced by placing under the patient's back a sandbag at, or a little above, the level of the liver (Fig. 320). Modern operating tables are supplied with an apparatus which achieves the object and may be raised or lowered as desired. Fig. 87 shows this apparatus affixed to the operating table. By this means the liver is made to be present in the wound, and access to the cystic and common duct is made comparatively easy. In addition to this, the head of the table may be elevated to the extent of 35°, causing the intestines to gravitate toward the pelvis. When the liver is held by retractors air enters between the liver and intestines, making still more accessible the operative field. A disadvantage of this position is that the abdominal muscles are made tense, and before the wound of approach is repaired, the horizontal position should be reassumed in order to relieve tension and make possible proper approximation of the abdominal wound.

CHOLECYSTOTOMY

Cholecystotomy, with fixation of the gall-bladder to the anterior abdominal wound, has been quite abandoned in favor of tube drainage of the gall-bladder, and at times fixation of the

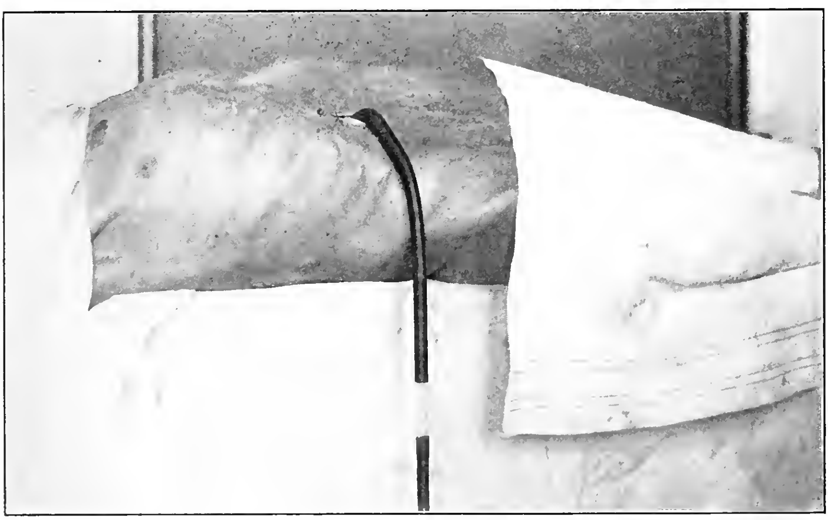


Fig. 321.—Drainage Arrangement Following Cholecystotomy.

fundus to the anterior peritoneum. As frequently the parietal peritoneum is quite merged with the sheath of the rectus abdominalis, this latter step is not always feasible nor is it, indeed, essential to a favorable outcome. This method of dealing with the gall-bladder has quite removed the necessity for prolonged care of the wound, following the older method of ventral fixation. The tube leading into the gall-bladder is connected by means of a glass pipette with a long rubber tube, which latter is led into a receptacle partially filled with an antiseptic solution affixed to the side of the bed (Fig. 321). For the purpose a wide tube, equivalent to 26° F., should be used. It will be found convenient to employ an angular rubber tube (Fig. 322), which, because of its conformation, is less likely to kink than if a straight tube is used. Drainage of the surface contiguous to the gall-bladder is made with a cigarette drain, which is brought out at the lower angle of the abdominal wound. If no evidence of infection be manifest at the end of the third day following the operation, the cigarette drain may be removed. The tube drain is left in the gall-bladder until the seventh day following the operation, when it is removed. The inverted serous surface of the gall-bladder comes in contact, as the rubber drain is removed, and closes the opening in a few days. During this latter time the valvular action of the inverted gall-bladder wall may not be sufficiently tight to obviate a certain amount of leakage of bile. However, the quantity of bile discharged is usually very small and soon ceases spontaneously. In any event, sufficient adhesions of the surrounding peritoneum will have formed by this time to prevent entrance of the secretion from the biliary passages into the peritoneal sac. It is obvious that the point of exit of the drain in the gall-bladder is not the same as that in the superficial wound, the latter being lower down, thus conserving isolation of the gall-bladder tract by adhesions.

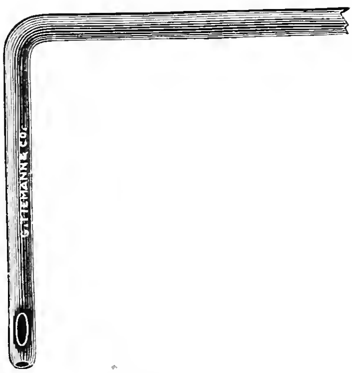


Fig. 322.—Angular Soft Rubber Tube, Useful for Drainage of Gall-bladder Following Cholecystotomy.

Practically the same method of procedure with respect to drainage is employed when *cysticotomy* is necessary for removal of stone impacted in the cystic duct. The gall-bladder is drained, as stated, and a separate drain is inserted down to the point of invasion of the cystic duct. In these cases it is best to leave the lower drain *in situ* five days, until repair of the wound in the duct is assured.

CHOLECYSTECTOMY

Cholecystectomy with immediate closure of the abdominal wound is rarely done, except perhaps when the gall-bladder is removed for neoplasm, a rare condition. Indeed, it may be laid down as a quite unmodifiable rule, that drainage of the biliary passages following invasion of their lumen is always indicated. Certain it is that if infection of the biliary passages have occurred, there is no reason to assume that the infective process will reverse the general law with respect to the action of infective process which in other situations extend in the direction of least resistance. It is, therefore, difficult to assume that infection is more liable to invade the gall-bladder than the hepatic ducts, and if there is one well-established law in surgery, it is that drainage is indicated when infection exists.

The technic of drainage of the biliary passages following cholecystectomy is, of course, not properly discussed here. Tube drainage is employed, and the postoperative care of the wound is in all respects similar to that following cholecystostomy. The cigarette drain which takes care of the field outside the biliary passages is left *in situ* until the fifth day following the operation and is then removed.

HEPATICOSTOMY, CHOLEDOCOTOMY, CHOLE AND CHOLECYSTENTEROSTOMY

These procedures all present the same picture as obtains with the operations just discussed. The postoperative treatment and removal of drainage agents being governed in a similar manner. In this class of cases, however, the rule is reversed and the drain in the area surrounding the tube is left in after the tube itself has been removed from the biliary passages. That is, the tube drain is removed on the fifth day, and the gauze drain is left in place until the eighth or tenth day after the operation, in order that should there be any leakage of bile after the tube is removed, it will be led to the surface by the latter drain. By the end of the tenth day the avenue of exit between the biliary passage and external wound will be sufficiently established to warrant allowing it to take care of itself in this respect. Daily cleansing of the wound at this time will be necessary, which did not obtain while the rubber tube led away the biliary secretions.

Biliary fistula at times follows this class of operations, but in the majority of instances spontaneous healing takes place. While there is much difference of opinion with respect to the question as to whether the secretion of bile into the gut is essential to life, it is best to give the digestive function the benefit of the doubt in the care of cases in which the biliary secretion is diverted from the gut as the outcome of operative measures.

During the repair of the wound and reëstablishment of the natural avenue of flow of the bile, the diet should contain as little fat as possible and the quantity of carbohydrates be reduced. It is true that the digestion of carbohydrates and the emulsification of fats are performed by the pancreatic juice, yet there can be no doubt that the bile contributes not a little to these functions. Again, when the common or hepatic ducts are attacked it is not improbable that the entire duct is interfered with and the pancreatic secretion is no doubt also impaired. The appearance of bile in the feces is the guide as to when full diet may be administered. The cessation of discharge of bile from the drainage openings does not mean that full diet may be partaken of at once.

Constipation and tympanitis are common complications following operations which divert the biliary secretions. These are, of course, taken care of in the usual manner. However, it is not improbable that the bile is an antiferment, and if the case present any especial difficulty in this connection, recourse may have to be had to the administration for a few days of sterile diet and isoform (page 430). Gastric lavage and cleansing of the colon are useful measures, and will afford considerable relief in instances where the symptoms are sufficiently marked to warrant their employment. The latter, that of colic lavage, may be employed in any event. The gastric lavage, because of the immediate contiguity of the field of operation to the stomach, must not be lightly undertaken, though if used judiciously and after twenty-four or more hours subsequent to the operation is a justifiable measure.

BILIARY FISTULA

Biliary fistula, as already stated, follows invasion of the biliary passages in a certain number of instances. When the gall-bladder has been drained by a tube around which it is inverted, the leakage of bile ceases in a few days after the drain is removed. However, a certain number of surgeons fasten the gall-bladder at the operation to the abdominal wall, with the view of obviating the occurrence of leakage of biliary secretions into the contiguous peritoneum.

This measure is followed by copious discharge of bile through the wound, which may persist for several months. During this time frequent changing of the dressings is necessary. The skin soon becomes excoriated, and unless great cleanliness is exercised, a distressing suppurative cellulitis of the tissues about the fistula occurs. This may be obviated by covering the skin with a rather thick layer of sterile zinc ointment, with the view of preventing contact of the biliary secretions with the skin.

The ointment is gently removed once daily with soap and water. For the purpose a pledget of cotton is used, and the ointment patiently removed as the outcome of prolonged manipulation, rather than as the result of harsh scrubbing with tincture of green soap and a brush. It must be remembered that the character of secretion, coming from the gall-bladder and ducts, is infective in character, and that trauma to the skin at this time favors the occurrence of cellulitis and abscess. The attendant may assure his patient that although a fistula of this sort at times persists for months, it will frequently heal spontaneously at the end of this time.

The mucosa lining of the fistulous tract is, as a rule, much thickened as the result of an inflammatory hyperplasia, and this membrane persists in secreting for a long time. It will be found expedient to apply to the tract tincture of iodin, carried into the lumen of the gall-bladder at intervals by means of cotton wound on a probe, with the view of destroying infection and stimulating repair. Pure carbolic acid may be used in the same way at intervals of one week. The latter should be neutralized, as far as contact with the skin is concerned, by a liberal lavage with alcohol (95 per cent.), though the alcohol need not be carried into the deep wound.

A few days after the application of carbolic acid sloughing of a superficial portion of the tract occurs, which may interfere with discharge of secretion. This will be manifested by evidence of inflammation, pain, tenderness and a slight rise of temperature. Introduction of a slender dressing forceps will permit of removal of the slough, and the reassumption of drainage is soon followed by disappearance of the manifestations mentioned. During the time that the bile is copiously discharged on the skin, the patient is apt to give some evidence of malnutrition. This occurs, of course, only when the fistula remains patent for a long time. However, the constitutional effect of withdrawal of the biliary secretion from the gut has in some instances caused sufficient emaciation as to arouse suspicion that the process in the gall-bladder was tuberculous. In these instances secondary operation, with the view of reëstablishing the normal discharge of bile into the gut, should be considered, and, indeed, this question should be taken up before the patient's general condition becomes sufficiently impaired as to influence the prognosis as regards the operation.

Patients who have been subjected to operation upon the liver do not frequently suffer from postoperative hernia. However, women past middle life, who have thin recti muscles and a pendulous abdomen, had best be furnished with an abdominal supporter (page 475).

TRANSPERITONEAL OPERATIONS ON THE UTERUS AND ADNEXA.

Approach to the female pelvis by the abdominal route calls for the same general and local preparation described under celiotomy.

Salpingectomy for gonorrheal salpingitis is likely to be followed by infection of the superficial wound, and this infection at times does not become manifest until the tenth or even the fourteenth day. It is a singular fact that evidence of peritoneal infection may not, and in the majority of cases does not, manifest itself at any time in the vast majority of the cases including those which are attended with infection of the superficial wound. This would argue that the peritoneum is better suited to take care of a certain amount of infection than the abdominal wound. There is a prevalent notion that pyosalpinx is an almost sterile process after the expiration of a certain period of time, and this is in a measure true. However, this should not engender a harmful complacency with respect to asepsis during the operative procedure. It is not improbable that the fact that there is no wide solution of continuity of the peritoneum during the operation, as compared to the sectioning of the abdominal wall, has some bearing on the greater susceptibility of the latter. The abdominal wound presents a surface in which the blood-vessels and lymphatics are freshly sectioned, and this presents a more favorable condition of affairs as regards infection than does the smooth peritoneum, which undergoes repair in a very short time after being injured.

In view of the frequency with which infection of the superficial wound occurs following celiotomy for salpingitis, the patient should be kept in bed for at least two weeks following the operation. When infection becomes manifest the wound is treated as already described (page 305).

Ovariotomy, hysterectomy, hysteromyomectomy, etc., are all taken care of as stated in connection with celiotomy. Catheterization of the bladder for postoperative retention of urine is more frequently necessary than after operations on other organs in the abdomen. This may be due to the trauma which the bladder is indirectly subjected to during the operation in this situation.

The *Trendelenburg* posture is more frequently employed during operations in the female pelvis than for any other class of cases. For the purpose a table so constructed as to permit of placing the patient in this position should be available. Fig. 90 shows the table placed in this position. The nurses should be careful to place the patient in such a position as to permit of attainment of the Trendelenburg position when the necessity for it arises without disturbing the relationship she bears to the table while in the dorsal posture. This is an important consideration, as, if the precaution be omitted, the changing of the patient's position may result in fertilization of the operative field. When the patient is placed in the Trendelenburg posture, the footpiece of the table is dropped by the non-sterile nurse, the shoulder braces are placed in contact with the shoulders, and the anesthetist raises the lower end of the table by means of the wheel (Fig.

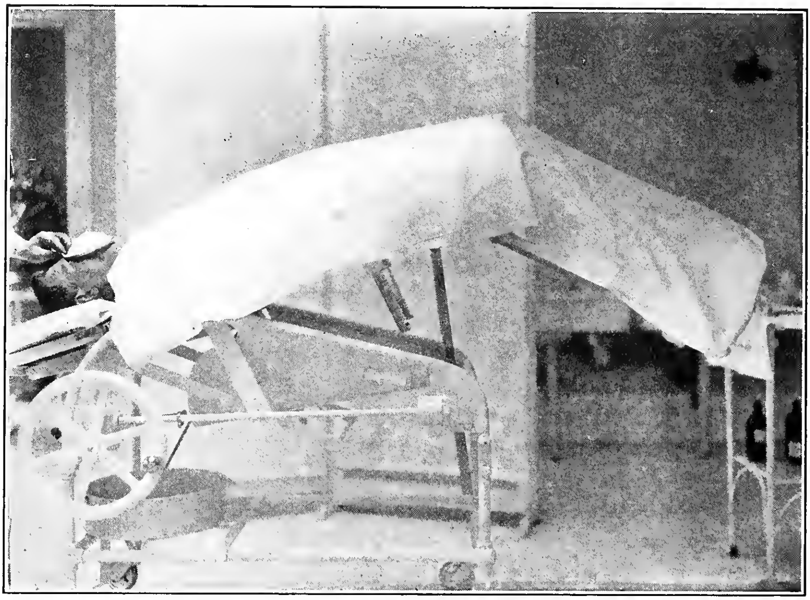


Fig. 323.—Patient in *Trendelenburg* Position, Draped for Celiotomy.

323) until the desired elevation is attained. Fig. 323 shows the patient placed in the Trendelenburg posture.

The postoperative complications following transperitoneal operations upon the uterus and adnexa are similar to those discussed under celiotomy, and are treated in the same way. As a rule, an abdominal supporter (Fig. 300) or a special corset (Fig. 302) should be worn for several months after celiotomy in this situation, as these organs are attacked through a portion of the abdominal wall, which is of necessity exposed to considerable strain and pressure.

CHAPTER XXVII

GYNECOLOGICAL OPERATIONS BY THE PERINEAL ROUTE

Position of patient—Isolation of operative field—Irrigation—Care during convalescence—The care of the wound—Vaginal drainage of pelvic abscess—Vaginal hysterectomy.

POSITION OF PATIENT

The vulva is shaved and cleansed in the manner described under preparation of the skin. Catharsis is employed the day

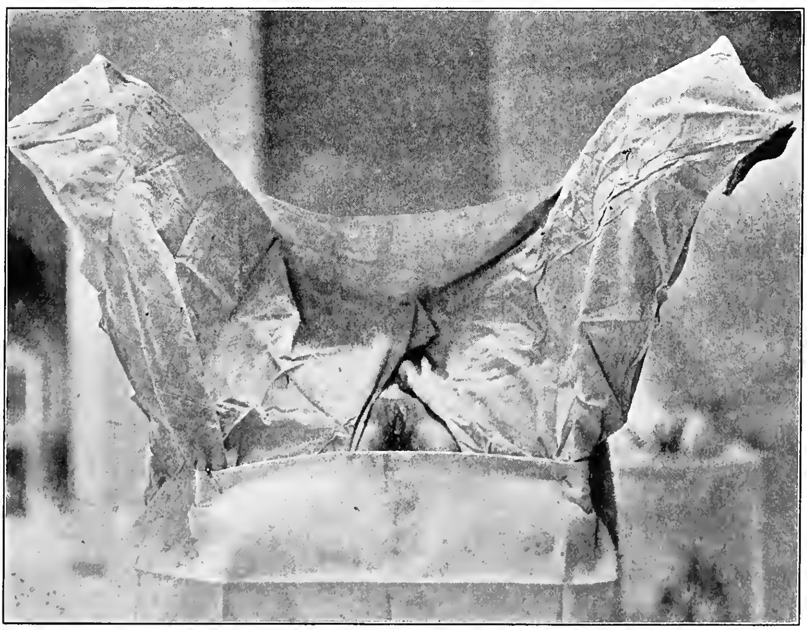


FIG. 324.—POSITION OF PATIENT FOR PERINEAL OPERATION. SURROUNDING PARTS PROTECTED BY STERILE DRAPERY.

before the operation, and no enema is given for six hours before the operation (page 41).

The position of the patient during the operation most commonly employed is the so-called lithotomy posture (Fig. 324). Modern operating tables provide for drainage when this position

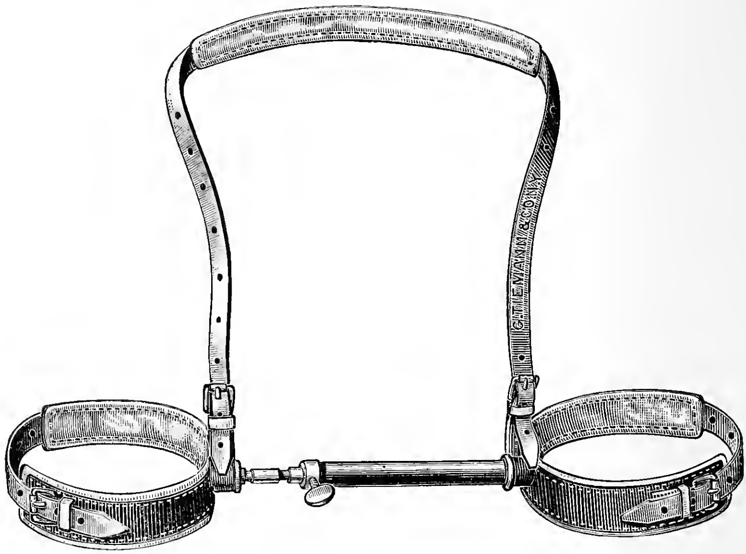


FIG. 325.—*Clover's* CRUTCH FOR "LITHOTOMY" POSITION DURING PERINEAL OPERATIONS. (*Keyes.*)

is employed. However, if no such arrangement is available, a *Kelly* pad (Fig. 13) is placed beneath the buttocks for the purpose. In private practice the lithotomy position, if a portable table (Fig. 134) is not available, may be attained by means of the *Clover* (Fig. 325) crutch or similar device. Portable uprights which clamp on the ordinary deal table and are furnished with foot straps (Fig. 326) are exceedingly convenient, and do away with the strain upon the shoulders which results when the crutch or similar device is used.

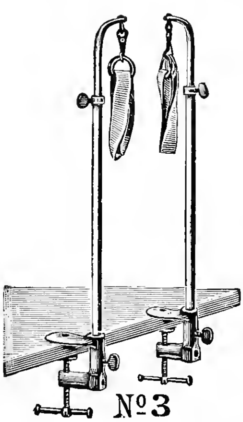


FIG. 326.—ADJUSTABLE LEG-HOLDERS FOR "LITHOTOMY" POSITION IN OPERATIONS ON THE PERINEUM.

It will be seen by the illustration that the leg-holders are inserted into canals in the clamps and held at any desired height by means of the set screws. This is desirable

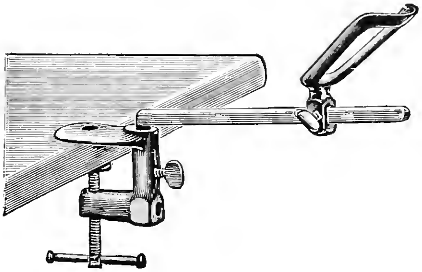


Fig. 327.—Portable Heel Cup, Useful in Cleansing Perineal Wounds after Operation.

with the view of adjustability with respect to varying lengths of legs. The fact that the clamps may be fastened to the table at any desired distance from each other makes the holders adaptable with regard to wide or narrow buttocks. In addition to this, the uprights telescope, which arrangement allows of their transportation in a moderately sized bag. The outfit is also furnished with heel cups (Fig. 327). The uprights are discarded and the clamps, after being attached to the edge of the table, receive the heel cups. This arrangement is very satisfactory during minor operations upon the perineum, etc., undertaken with local anesthesia, and also will be found exceedingly useful in the local treatment of cases subjected to operations in this situation when changing dressings or treating the wound after operation. When the uprights are used, after the case is

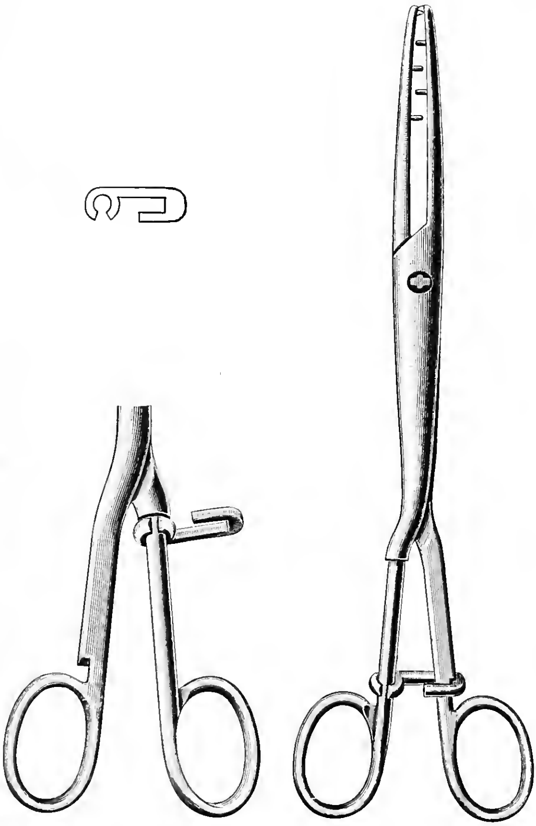


Fig. 328.—*Miller's* Sponge Holder. The hook shown above, in outline, hangs loose on the handle until the forceps are locked, as seen in the right-hand figure. (*Kelly*.)

narcotized, the knees fall apart and the parts are readily accessible, as shown in Fig. 324.

When the patient is postured on the table as indicated, the vulva is again cleansed and the vagina sterilized. For the latter purpose tincture of green soap is introduced into the vagina, and the vaginal walls scrubbed by means of a gauze sponge introduced with a sponge holder (Fig. 328). This instrument holds the sponge firmly in its jaws, and the lock at the handles does not permit the jaws to open while manipulating the instrument in deep cavities. The loss of a sponge is no great calamity in this situation. However, a similar accident while the instrument is introduced into the abdominal cavity from below would take on a serious complexion.

The soap lather is now displaced with an irrigation of warm sterile water, the vagina being "ballooned" by holding the labia in apposition, to distend the folds of the mucosa and remove entirely the lather. A douche of 10 per cent. creolin is then given, followed by a copious vaginal irrigation with corrosive sublimate 1 in 2,000, and finally a douche of sterile water is employed.

ISOLATION OF OPERATIVE FIELD

The sterile isolation of the operative field is accomplished by placing over either leg and leg-holder roomy leg-covers made of linen, which are brought together over the pubis, giving space enough over the perineum to leave exposed the operative field. A towel is placed transversely across the anus and buttocks and fastened to the leg-holders on either side. The abdomen is covered with a sterile towel. Fig. 324 shows the patient prepared as stated. This method of preparation has the advantage over that of placing a large sheet over the parts and cutting a hole in it corresponding to the operative field, inasmuch as the former method permits of frequent changing of the lower towel during the operation with but little disturbance of the contiguous surfaces and a minimum of interference with the operative procedure.

IRRIGATION

Irrigation, though not generally employed in operations in other situations, should be provided for in this connection. During the operation a stream of normal saline solution may be intermittently directed against the operative field in order to facilitate the manipulations, such as removal of blood which obscures the field. For the purpose a ball and socket nozzle will be found convenient (Fig. 329). This little apparatus can be manipulated

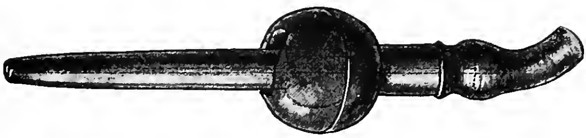


Fig. 329.—Swedish Hard Rubber Ball and Nozzle Irrigator. By bending the nozzle in the ball at an angle, the flow is controlled or altogether arrested. (*Kelly.*)

with one hand, and the force of the stream readily controlled or the flow may be arrested altogether.

Following plastic operations in this situation, *Kelly* thoroughly drys the operative field with pledgets of dry sterile cotton.

A strip of iodoform gauze may then be inserted into the vagina, as far up as the cervix, loosely filling the upper vagina and just appearing at the outlet; this should be taken out in five or six days and the vagina douched daily afterward. It is my practice at present to use no vaginal dressing at all, but simply to protect the vulva by a sterilized gauze pad held in place by a T-bandage.

The pad is changed several times daily, and if there is any offensive discharge, the vagina is douched out with warm boric or carbolic acid solution once or twice a day. I have found a powder composed of boric acid 3 ounces, alum 1 ounce, carbolic acid ½ ounce, and oil of peppermint 1½ drachms, very satisfactory in relieving the odor and irritation which are sometimes distressing during convalescence from a plastic operation.

Before removing the patient from the table, draw the urine with a glass catheter, loosen the leg-holder, and raise the buttocks by carrying the feet of the patient toward the head, dry the genitals, buttocks, and back with a towel, and remove the drainage pad. The external genitals should be powdered with iodoform and boric acid (1-7), and then covered with a loose pad of sterile cotton, held in place by a T-bandage. (*Kelly.*)

CARE DURING CONVALESCENCE

The care during convalescence frequently determines the ultimate result. While the patient is coming out of narcosis the legs may be tied together with a broad towel, to obviate strain upon the sutures. As soon as consciousness returns, the restraint should be removed and the coöperation of the patient depended upon to avoid this occurrence. Following operations upon the perineum, the patient is confined to bed for two weeks, during which time the bed pan is used. Evacuation of the bladder and rectum in the sitting posture brings strain to bear on the sutures and should be avoided. When the cervix uteri alone is involved, the patient may leave the bed on the seventh day after the operation, and may empty the bladder and rectum in the sitting position after the third day.

The vaginal pack may be removed when discharges appear at the vulva, though, as a rule, the pack may be left in place for six days following the operation. In removing the pack the labia should be carefully separated and the gauze thoroughly moistened with an antiseptic solution, which at the same time removes the secretions from the labia. The pack is then seized with dressing forceps, care being taken not to pinch in at the same time the contiguous mucous membrane. With a twisting motion the pack is slowly and gently loosened, as is described under removal of the *Mikulicz* tamponade (page 268), and removed. The nozzle of the irrigator, which should be blunt, is introduced downward and backward, and the vagina cleansed with a copious lavage. After the douche the parts are dried with sterile gauze and dusted with aristol or the powder mentioned above.

Catheterization in these cases deserves special consideration. The urine, when passed spontaneously, very soon soils the operative field, and, while the parts may be cleansed before and after the act of urination, it is probable that catheterization at intervals of eight hours for three days after the operation is a better plan of procedure. The introduction of the catheter is performed in the following manner:

The labia are gently separated and the mucosa contiguous to the urethral meatus is cleansed with pledgets of sterile cotton soaked in 1 in 200 carbolic acid solution. The catheter, which should be of glass and boiled before use, is then passed, and after the bladder is evacuated the parts are again treated in the manner employed before introduction of the catheter. If a skillful nurse or a physician is available, the latter measure is more certain in result as regards cleanliness of the perineal wound. However, if these conditions are not obtainable, the method of preliminary and subsequent cleansing is attended with less danger of infection, provided no cystitis has existed before the operation. In the latter event, the catheterization, together with bladder lavage, should be employed. When the catheter is withdrawn the finger should be placed over its distal opening to prevent dribbling of the urine contained in its lumen over the wound. During these manipulations rubber gloves should be worn, which will make contamination less liable to happen. Subsequent to either of the manipulations the parts are dusted with one of the antiseptic powders mentioned.

Catharsis is provoked on the second day after the operation. A cathartic is given the evening of the second day, and this supplemented by an enema the following morning. For the purpose the patient is postured on the bed pan and the anus and surrounding tissues cleansed in the manner similar to that employed about the urethra. The nozzle of the syringe is gently pushed into the bowel, care being taken to avoid unnecessary contact with the anterior surface of the rectum.

After the bowels have moved, the anus and surrounding surface are again cleansed in the manner stated, and the parts dusted with an antiseptic powder. When the anal outlet is being cleansed subsequent to the fecal expulsion, the pledgets should be wiped over the anus from before backward, to avoid dragging feces toward or into the wound.

THE CARE OF THE WOUND

The care of the wound depends somewhat on the character of operation performed. The precautions with respect to cleanliness as regards urination and defecation have already been discussed. All manipulations should be conducted with gentleness, and contact of the fingers with the wound avoided. For the purpose cotton or gauze pledgets held by forceps should be employed.

Removal from the perineum of stitches which emerge on the skin may be done on the eighth day. Those within the vagina may be left in place until the twelfth day, as their removal involves some trauma to the line of union, and firm healing may not be expected until the expiration of this time. With the proper exercise of cleanliness, as stated, sutures emerging upon the vaginal mucosa may safely be left *in situ* for two weeks. The cervical sutures may remain in place for a long time. Silk-worm gut is largely employed for the purpose, and this agent does not infect very readily. In any event, it may be said that, if the perineum have been repaired simultaneously with the cervix, the sutures in the latter need not be removed for four weeks following the operation, at which time firm repair of the perineum has taken place. For the purpose of removing the stitches from the perineum the field is cleansed with a solution of boric acid, which will remove quite readily the crust of exudate and powder, making visible the stitches. This may be repeatedly done for several hours before the stitches are removed, the measure being executed by the nurse. The patient is then postured in the *Sims* position, the nurse or assistant holds apart the buttocks, and the stitches are removed in the manner described above (page 304).

In removing sutures from the cervix, the patient is placed in the *Sims* position, the posterior vaginal wall retracted and the cervix seized with a small volsellum. The stitches are seized with forceps and removed, cutting the suture material near the knot. This latter step, that of removal of stitches from the cervix, should be done in a good light, and an assistant should be available to hold the speculum and volsellum.

After repair of the wound the patient is subjected to a general tonic treatment. In cases of operation for plastic repair, especially where the sphincter ani has been involved, the patient's mental status is apt to be somewhat demoralized. *Kelly* regards systematic exercise with intervals of rest as important in these cases following the operation. It is, no doubt, true that the enfeebled muscular tone of the patient has some bearing in this connection, and that measures directed toward improving the general condition has an influence with respect to rapid return of normal contractility of the muscles of the perineum.

Indulgence in the sexual function should be abstained from for two months following plastic repair of the vagina. It is difficult to lay down a hard and fast rule in this connection. It is, however, probable that in most instances complete repair is conserved if this rule be followed.

Infection is manifested in this situation in the same manner as obtains elsewhere. If infection occurs at the seat of one of the sutures, it should be removed at once. Infection in the tissues contiguous to the line of union should be treated with early incision and drainage with strands of silk-worm gut. In this way extension of the process may frequently be avoided. At times abscess of one of the glands of *Bartholin* occurs. This is incised early, for the reason stated. If infection of the entire wound occurs, the stitches should be removed. However, the deep sutures of silk-worm gut should be kept in place until the last; drainage is accomplished at either side, with the view of obtaining apposition by granulation healing when the infection subsides. In this way, while a favorable cosmetic effect will probably not be achieved, sphincteric control is at times accomplished, and an important factor in the case is eliminated.

VAGINAL DRAINAGE OF PELVIC ABSCESS

Vaginal drainage of pelvic abscess is prepared for, as stated above (page 521). After the abscess is opened the residual cavity is loosely packed with iodoform gauze, a second loose packing of the same material is introduced into the vagina, and a gauze pad

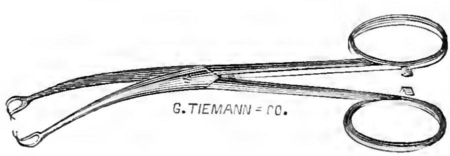


FIG. 330.—CURVED VOLSELLUM FOR HOLDING CERVIX UTERI DURING MANIPULATIONS.

applied to the vaginal outlet, which is held in place with a T-bandage or vulvar pad (Fig. 344). The gauze packing in the sac is not disturbed for three or four days, at the end of which time the patient is placed in the lithotomy position (Fig. 324), the external parts are cleansed in the usual manner, and the vaginal pack is removed. The posterior vaginal wall is retracted and the cervix held forward by means of a volsellum (Fig. 330), exposing

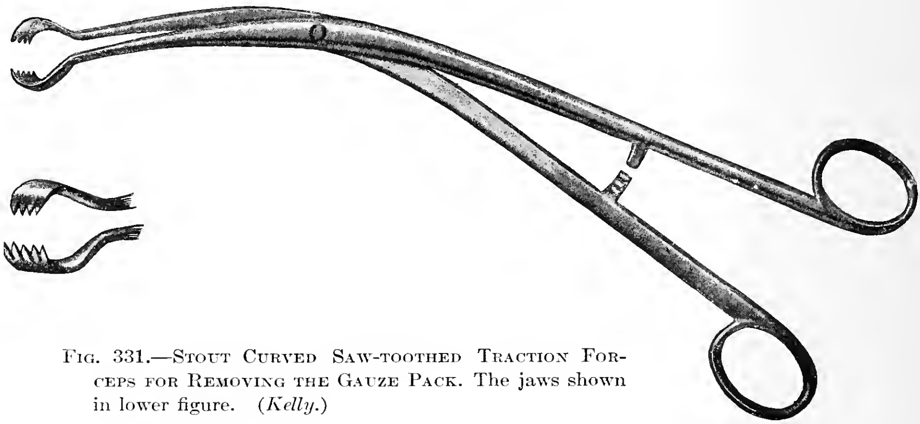


Fig. 331.—Stout Curved Saw-toothed Traction Forceps for Removing the Gauze Pack. The jaws shown in lower figure. (*Kelly*.)

the packing in the sac. The latter is at times left long and extends well into the vagina, making unnecessary the manipulation of the cervix at this time in the manner stated.

The protruding gauze is seized with a saw-toothed forceps (Fig. 331) and withdrawn. The cervix is now seized with the

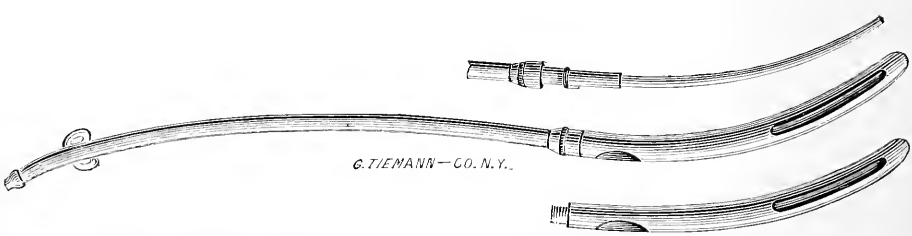


Fig. 332.—*Bozeman* Return Flow Metal Irrigating Tube Used for Cleansing Interior of Cavities. The instrument may be taken apart as indicated above and cleansed.

volsellum in the manner stated above and the abscess cavity irrigated. For the purpose, ample provision for return of the cleansing fluid should be made, and the vaginal speculum should be left *in situ*. For the purpose of cleansing the abscess cavity, the metal intrauterine return flow instrument shown in Fig. 332 will be found to meet the indications. In the absence of this instrument the *Kemp* tube (Fig. 345) will be found to answer the purpose. The former discharges the return flow into the vagina and cleanses it at the same time, and may be regarded as the more useful instrument for the purpose. The lavage should be preceded by cleansing of the vagina, and the usual asepsis should be observed throughout the manipulation, for although an infected cavity is being treated, the introduction of additional infection, the character of which may be more virulent than the one existing, should be avoided.

After the cavity is cleansed a fresh packing is introduced by means of a long dressing forceps (Fig. 333). This manipulation

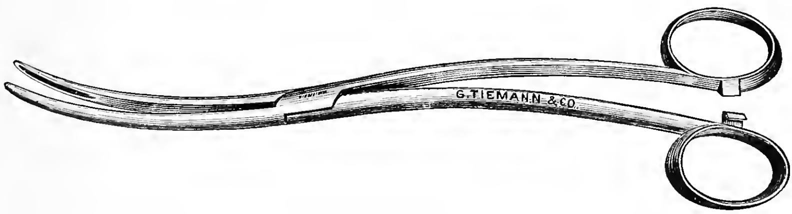


FIG. 333.—UTERINE DRESSING FORCEPS, USEFUL FOR REMOVING GAUZE FROM *cul-de-sac*.

is repeated until the discharge from the sac ceases, which requires in uncomplicated cases about two weeks. The patient is encouraged to assume the sitting posture after the first change of the packing, with the view of promoting drainage, and is allowed to leave the bed on the tenth day following the operation.

Fecal fistula follows section of the posterior vaginal vault in a certain number of cases. The fact that discharge of feces per vaginam does not, in a large number of cases, occur until the fifth day or later after the section, suggests that the inflammatory process produces sloughing of the anterior rectal wall and the fistula is not established until the slough separates. In another number of cases the rectum is injured during the operative procedure. In either event, the discharge of the feces from the vagina heralds the establishment of the fistula, and when the pack becomes odoriferous it should be at once removed and the abscess cavity cleansed in the manner described above. After the fistula is established care must be exercised in administering enemas, though the rectum should be cleansed daily by means of the *Kemp* tube. The abscess cavity is cleansed daily and a gauze wick introduced. Packing should not be employed, and the vagina should be douched twice daily. Spontaneous repair of fistulæ in this situation occurs in most instances, the cervix becoming adherent at its site and obliterating the opening. Scrupulous attention to cleanliness should be employed in the manner indicated during the healing. During the cleansing of the vagina a rectal speculum should be introduced through the anus, to obviate collection of the fluid employed for the purpose in that organ. During lavage of the rectum the vagina should be kept open with a bivalve speculum to permit of ready egress of the fluid, which may enter the abscess cavity through the fistulous opening.

VAGINAL HYSTERECTOMY

Vaginal hysterectomy is attended with control of bleeding by either clamps or ligatures. When clamps are used, those arranged with detachable handles are employed, and the blades left *in situ.* The instruments are surrounded with an iodoform gauze roll which extends well up into the vault of the vagina. The presence of the clamps and gauze makes a line of communication with the peritoneum, a condition of affairs favorable to infection, and the suggestions offered with respect to cleanliness and the care of the bladder and rectum must be thoroughly executed. With the view of obviating contamination of the field with urine, a retention catheter (page 569) is placed in the bladder and led into a conveniently placed vessel. Fig. 334 shows the clamps rolled in the gauze and the retention catheter *in situ.*

Patients who have been subjected to vaginal hysterectomy, after which clamps are left *in situ,* suffer considerable pain, necessitating the administration of opiates. The anodyne should be given in sufficient quantity to control the symptom. It is wise to administer hypodermically one-third of a grain of morphia under the skin, before narcosis is recovered from, as the restlessnesss consequent to the pain, together with the semi-consciousness, may result in disturbance of the clamps. Administration of the opiate should be repeated as the indications present. Peritoneal pain is very severe and the crushing of the broad ligaments within the jaws of the clamps creates a condition of affairs which it is easy to understand would provoke much suffering. Defecation is not likely to occur for forty-eight hours, for obvious reasons, and the

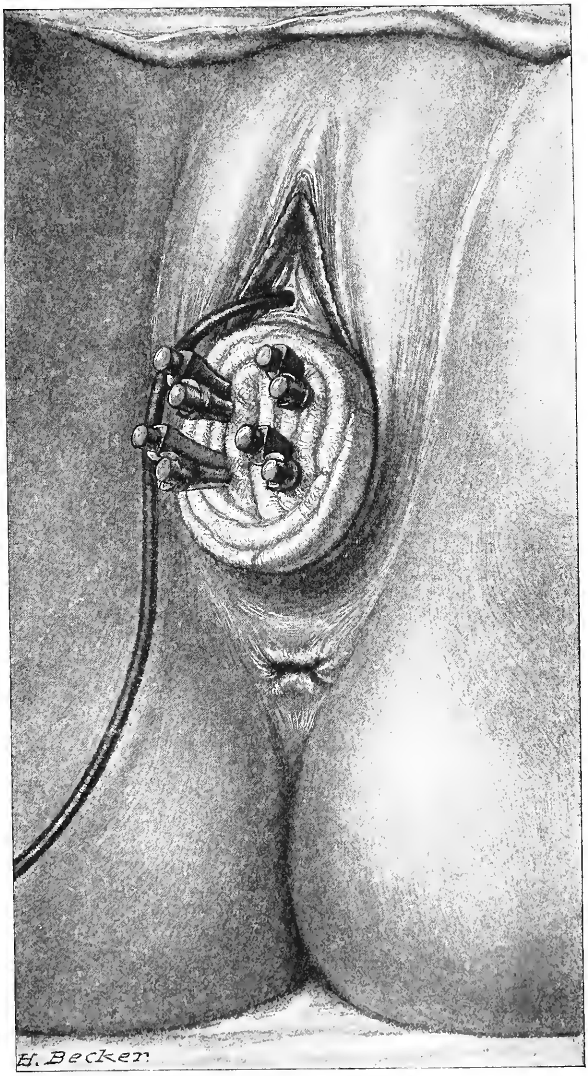


FIG. 334.—HYSTERECTOMY CLAMPS ROLLED IN GAUZE. (*Kelly* and *Noble*.)

introduction of enemata should be carefully executed under aseptic precautions.

The catheter is changed for a second sterile one at the end of twenty-four hours, at which time the bladder is lavaged with boric acid solution. At the end of another twenty-four hours the catheter is removed, the bladder again irrigated, and the gauze roll and clamps removed.

For the purpose the gauze is thoroughly soaked with an antiseptic solution (corrosive sublimate 1 in 2,000). The clamps will be found quite coated with secretion and rust. The intra-abdominal portions of the clamps are in a similar condition, and shreds of crushed tissue cause the blades to stick rather firmly. In removing the clamps this should be borne in mind. After the handles are affixed to the blades the locks are released without making any downward traction. If the portions of the blood-vessels obliterated by the pressure are torn away, bleeding will occur. After the clamps are released portions of the broad ligaments adhere to the interstices between the serrated surfaces of the clamps, even after the jaws are separated. Downward traction must not yet be made. The clamps are slowly rocked from side to side on the arch of a circle, and after this manipulation has been several times repeated the clamp may be withdrawn. As a rule, the highest clamp is removed first, permitting of steadying of the ligament with the lower ones.

When these manipulations are performed, the patient should be brought to the edge of the table or bed and a good direct light should be available. At times the clamps are removed while the patient is in bed. This is advised against, as the position of the clamps with respect to the direction of the body has a tendency to let the protruding portions of the clamps point backward, and when the handles are raised undue damage to the stumps of the ligaments is caused. The clamps should be released and loosened at the angle of their introduction with the view of accomplishing the purpose, as stated above. When ligatures are employed for the arrest of bleeding they are usually left long, their ends being allowed to just reach to within the vaginal outlet. The vaginal vault and the space between the broad ligaments is loosely packed with gauze and the vagina itself filled with gauze packing.

The gauze packing holds the rectum, bladder, and intestine away from the wound and drains the operative field. The gauze should be loosely introduced, the firm insertion of the packing interfering with drainage. However, when the packing is insufficient in quantity, the object with respect to keeping the contents of the abdomen away from the wound is not attained. This is true as regards subsequent dressings, and the introduction of the gauze should be always accomplished with the patient in the lithotomy position and under guidance of the eye, the vaginal walls being held apart with a vaginal speculum or by means of tractors held by an assistant.

Evacuation of the bowel is allowed to occur on the third day after the operation. A cathartic is administered in the evening and the following morning an enema of sterile water and soap is given. The latter act is, as has already been stated, carried out with careful aseptic technic and the contiguous surfaces are thoroughly cleansed after the bowel is emptied. The discharge of feces is made to occur after the clamps are removed, and there is little danger of infection occurring at this time from contamination with feces. However, the precautions mentioned should be observed.

When ligatures are employed the gauze packing in the vagina need not be disturbed for four or five days after the operation, and pain is not so great a factor in the after care. If the gauze packing in the vagina is saturated with secretions before this time, it should be changed. It is best to leave the gauze *in situ* for the four or five days, as in this way the contents of the abdomen are kept away from the surfaces of the cut vaginal vault until a certain amount of repair has taken place. Theoretically this lessens the dangers of postoperative infection.

As a rule, a certain amount of sloughing of the edges of the sectioned vagina and broad ligaments follows the operation. This interferes with healing, and while the sloughs are separating, the intestine should be kept from coming in contact with the wound surfaces in the manner stated. Repair of the vaginal vault does not, at times, occur until weeks after the operation. If the repair is permitted to go on without guidance, a loop of small intestine partially prolapses into the space at the vault of the vagina in some instances, and becomes adherent in this situation. The writer has seen cases of this sort, and in each instance celiotomy and suprapubic repair of the vaginal vault was made after the intestine has been loosened. The latter step was regarded as dangerous when attempted from the vagina. The ultimate repair contemplates repair of the vaginal vault with the rectum and bladder forming the dome above the vaginal scar. With this in view, the parts should be manipulated at each dressing, making smaller and smaller the tamponade until healing is complete.

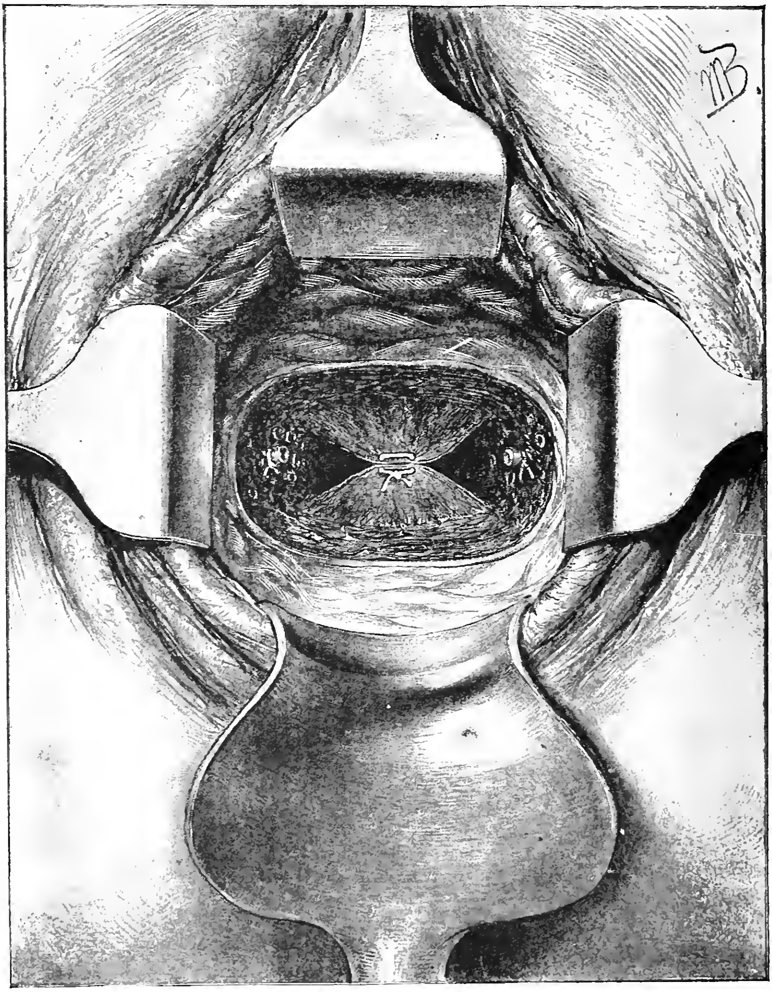


Fig. 335.—Appearance of Vaginal Vault after Vaginal Hysterectomy. Vault of Vagina Held in Place with Stitch. (*Kelly.*)

At times a stitch is taken in the center of the vaginal vault holding together the peritoneum (Fig. 335). This obviates, to a certain extent, the contingency related above, holding away from the vaginal vault the small intestine. In these instances the packing is introduced on either side of the stitch, and the rest of the local after-treatment executed in the manner stated above.

During the after-treatment, douching of the vagina is permissible, but should be performed when the patient is on the table, as described, and the cleansing made through a speculum to avoid the carrying of infection into the peritoneum. At times shreds of sloughing tissue may be removed with the dressing forceps. On the whole, the after care following vaginal hysterectomy is attended with considerable labor, and should be patiently carried out.

When infection occurs, following either the use of clamps or ligatures, the case is treated in the manner in which infection is taken care of elsewhere.

Fecal or urinary fistulæ follow vaginal hysterectomy in a small percentage of cases. In some instances sloughing extends into either the rectum or bladder. If this occur, the packing must be changed daily and the parts cleansed very thoroughly at each sitting.

Enemata are given under the precautions described in connection with drainage of pelvic abscesses (page 531). The bladder is kept clean, and if the fistula into this organ is considerable in size a retention catheter may be introduced into the bladder (Fig. 336) and the latter is taken care of as stated (page 533).

Cystitis follows vaginal section by the perineal route in a certain number of cases. Ordinarily, acute cystitis with pus, mucus and blood in the urine, subsequent to the operation, will subside under mild treatment without the necessity of local treatment. The pain and tenesmus are frequently relieved by the administration of

℞ Kali citrat.................4 drachms
Tr. hyscyomi...............6 drachms
Elix. simpl.........q. s. ad 6 ounces

S. Tablespoonful every two to three hours in water.

When the more acute symptoms subside, urotropin in five-grain doses may be given and the anodyne mixture administered at night.

If pus is persistently present, irrigation of the bladder with boric acid solution may be made once daily. For the purpose a "two-way" catheter may be used, the upper connection being attached to a long rubber tube connected with a funnel. To the lower outlet is attached a rubber tube draining off the fluid. Fig. 336

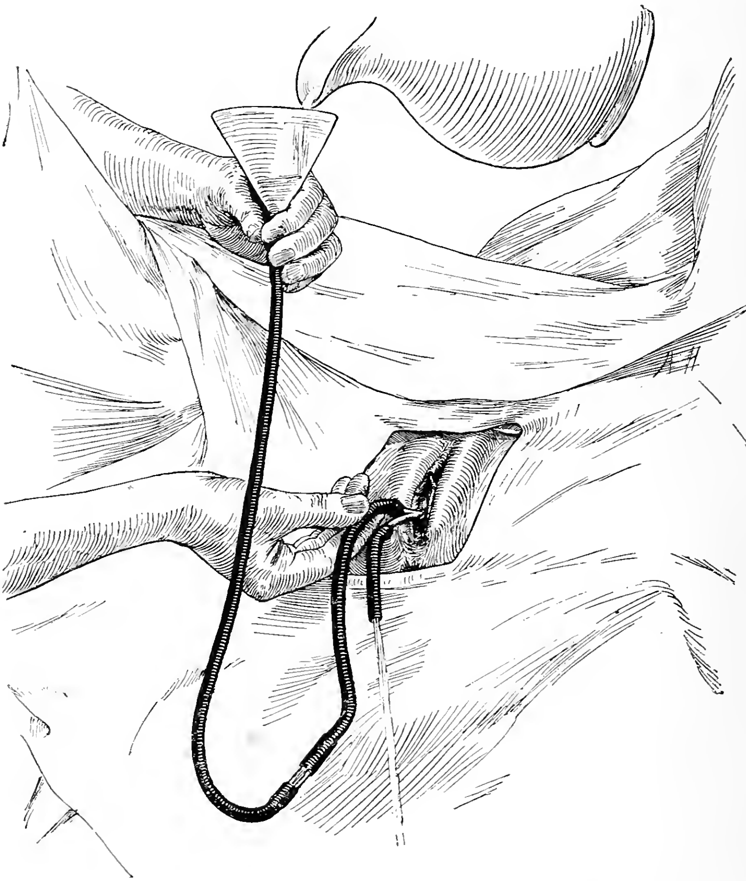


FIG. 336.—IRRIGATION OF BLADDER WITH "TWO-WAY" CATHETER. (*Kelly.*)

shows the apparatus in use. Care must be exercised not to permit the funnel to become empty during the manipulations, or air will be sucked into the bladder by the entering column of water and distressing tenesmus is provoked. The advantage the method has over the use of the irrigator or syringe is that the pressure is easily regulated by the elevation of the funnel, and this should not be held higher than will provoke a moderately rapid flow of cleansing fluid into the bladder. By lowering the funnel to below the level of the bladder the contents can be siphoned off.

The measures related above usually achieve the purpose in a few days. However, in a certain number of cases the symptoms persist, and, indeed, chronic ulcerative cystitis has occurred under the conditions mentioned.

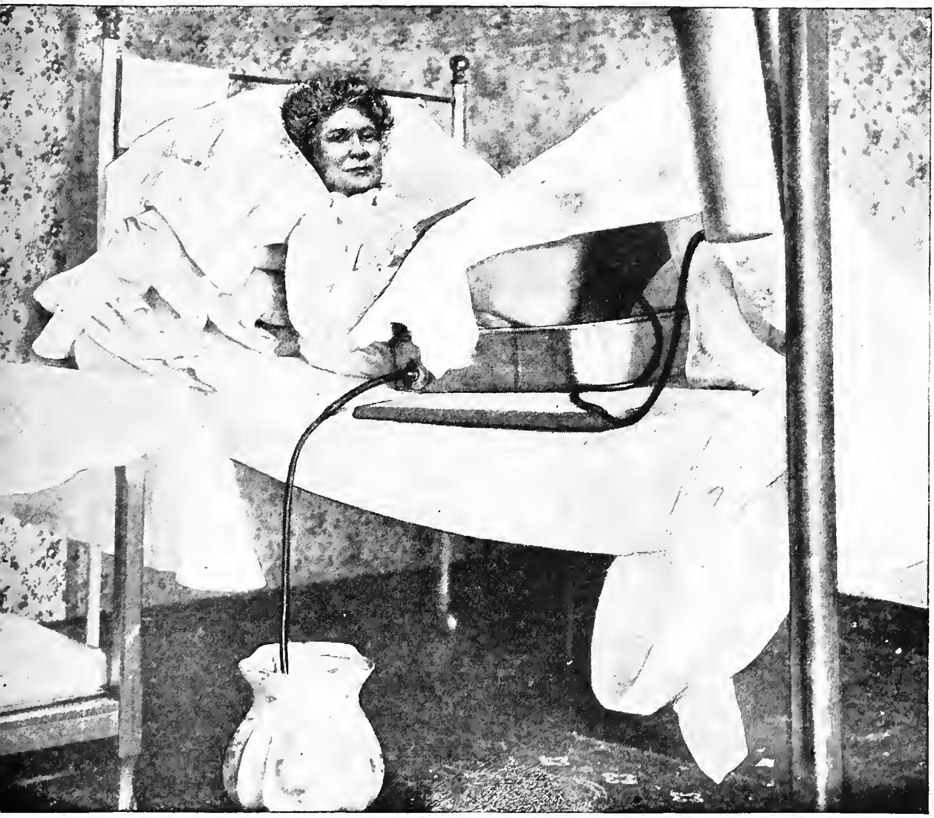


FIG. 337.—METHOD OF CONTINUOUS IRRIGATION OF BLADDER WITH PATIENT IN BED ON BED PAN. (*Kelly*.)

Kelly employs in these cases irrigation of the bladder, as stated, using a solution of nitrate of silver (1-1,000) for the purpose. A small quantity of the solution (4 ounces) is left in the bladder to be voided at the next urination. In very obstinate cases, where ulceration is present, *Kelly* subjects the bladder to continuous irrigation with a warm boric acid solution. The patient is postured as shown in Fig. 337. A double soft rubber catheter (Fig. 336) is introduced through the urethra into the bladder, and held in place with a perineal pad fastened with a tape around the waist. The upper catheter is connected with an irrigator, as shown in the illustration, the lower one is led into a pan, and the latter drains into a jar, as shown in Fig. 337. The irrigation may be maintained for several hours at a time, at the end of which time the irrigating tube is disconnected and the bladder emptied. An instillation of nitrate of silver solution, as stated above, is introduced into the bladder. Exceedingly obstinate cases of infection of the bladder will yield to this form of treatment.

CHAPTER XXVIII

OPERATIONS ON THE RECTUM AND ANUS

Operations on the rectum by the sacral route—Operations on anus and rectum by the perineal route—Fistula in ano—Removal of hemorrhoids—Prolapse of rectum, perineal proctectomy, from the rectum and excision of tumors.

When the rectum is approached by the transperitoneal route, the preparation of the patient and subsequent care and treatment do not differ from those described above in connection with celiotomy and invasion of the gut. Manipulations about the rectum

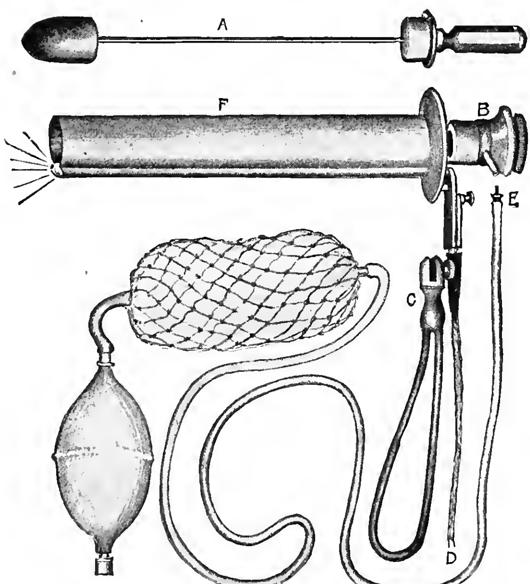


FIG. 338.—*Tuttle's* PNEUMATIC PROCTOSCOPE. (*Tuttle.*) *A*, obturator; *B*, plug with glass window for closing tube; *C*, handle; *D*, cords connecting instrument with battery or street current; *E*, inflating bulb; *F*, main tube of proctoscope.

in postoperative cases will be found greatly facilitated by employing the outfit shown in Fig. 338. Facilities for the necessary electric energy are not at all times available. Under these circumstances the outfit shown in Fig. 342 will be found to meet the indication, though perhaps with less comfort to the surgeon than that shown in Fig. 338. The outfit shown in Fig. 338 has the advantage of permitting of inspection and treatment of conditions in the rectum without the use of indirect light. In addition to this, the forceps shown in Fig. 339 will be found a useful addition to the armamentarium, especially in cleansing the rectal wound with gauze or cotton wipes. The forceps has the lock arranged in such a manner as to permit of opening and shutting in a small space.

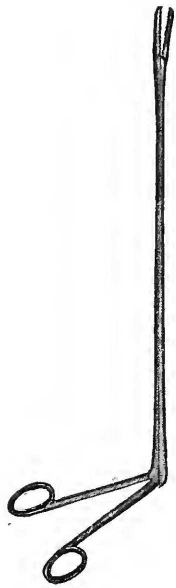


Fig. 339.—Alligator Forceps for Cleansing Wound of Rectum. (*Tuttle.*)

OPERATIONS ON THE RECTUM BY THE SACRAL ROUTE

Operations of this sort usually involve much trauma and consequently are frequently attended with considerable shock. Ample provision should be made to meet the indications in this regard (page 229). The administration of nutritive constituents and stimulants by rectum, following operations in this situation, is, of course, attended with some difficulty, though enteroclysis may be employed, provided the solution is rendered sterile and asepsis be conserved during the administration.

Extirpation of the rectum by the sacral route, when it is possible to maintain the anal outlet in the normal position, is less likely to be followed by infection than when an artificial anus is made in the wound.

Fig. 340 shows the appearance of the wound and anus in the class of cases where the anus is left intact. Drainage of the wound is employed to lead off any leakage which may occur at the seat of rectal trauma, and, also, as this method of attacking the rectum involves the fashioning of a bone flap, to permit of the exit of secretions from the surfaces of the sectioned bone. A certain amount of necrosis of the bone occurs in most instances, and the drainage opening will permit of discharge of the separated particles of bone tissue. It will be seen by the illustration that a rubber tube of considerable caliber is introduced into the

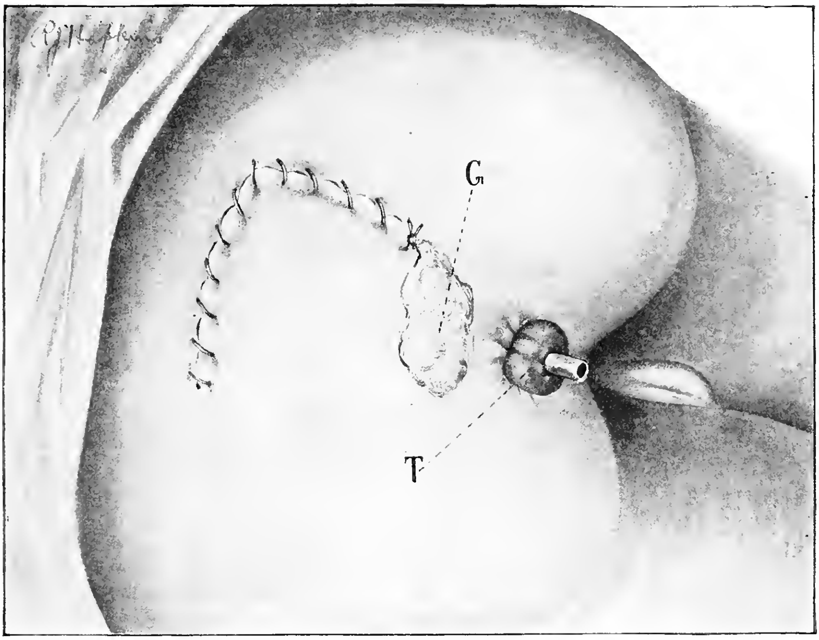


FIG. 340.—APPEARANCE OF WOUND AFTER EXCISION OF RECTUM BY THE SACRAL ROUTE. *G*, Gauze draining retro-rectal space; *T*, Tampon and drainage tube in anus. (*Tuttle.*)

rectum through the anus, which is surrounded with gauze, and serves the purpose of permitting of easy expulsion of gas and discharge of secretions. Distention of the rectum and sigmoid following this class of operations is exceedingly distressing to the patient and interferes with ready repair of the wound in the gut. The drainage tube also gives an avenue of egress to the secretions from the wound in the gut.

The rubber tube should be fenestrated (Fig. 143) and be passed beyond the line of union in the gut. The distal portion of the tube may be connected with a long flexible tube, which is led into an appropriate receptacle described under colectomy (page 505). When the nature of the affliction for the relief of which rectal extirpation has been undertaken makes maintenance of the normal site of fecal discharge impossible, the proximal end of the gut is sutured into the wound in the manner shown in Fig. 341.

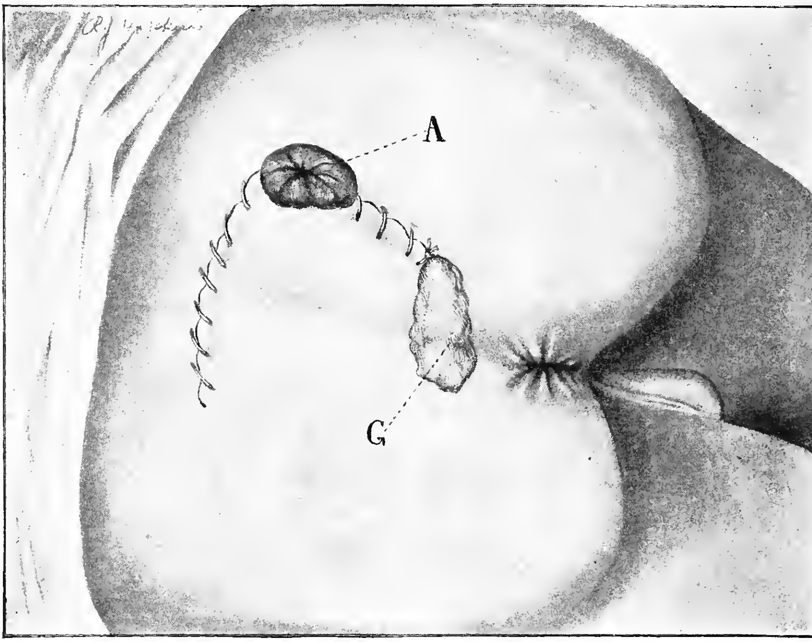


Fig. 341.—Appearance of Artificial Anus After Sacral Resection of Rectum. (*Tuttle.*) *A*, Artificial anus; *G*, Gauze drain.

While the protective dressing need not be changed for several days following the operation where the normal outlet for feces is maintained, the wound must be dressed daily or more often when an artificial anus is made.

In either event the bowel is quieted with an opiate, and no catharsis is provoked for four or five days following the operation, with the view of lessening the dangers of infection from feces. The postoperative diet should be bland and contain no substances which leave large residuum for expulsion by the rectum. The precautions taken up under the general head of intestinal operations should be observed.

When finally catharsis is employed, a saturated solution of magnesium sulphate in doses of one drachm every hour will result in catharsis in about five hours after beginning of the dosage.

Two hours after beginning of the medication four ounces of sterile olive oil warmed to the temperature of 105° F. are gently injected into the bowel either through the drainage tube or artificial anus. One hour later, a half pint of a solution of sodium carbonate 2 per cent. is injected in the same way. Cleansing of the bowel in this manner is attained thus with but little disturbance to the patient. The catharsis should be so arranged as to have the ultimate outcome occur at a time when cleansing of the wound, which should be done soon after the bowel is emptied, is made by the attendant. In the event of a spontaneous discharge of feces before this time, or if the surgeon is not promptly available when the discharge of feces occurs, the nurse should remove the dressing and cover the wound with a wet antiseptic dressing until the proper dressing is applied.

The superficial drain may be removed on the fifth day if no infection have occurred. If the wound is contaminated, it is treated along the lines stated above in this connection. The wound shown in the illustration is closed with a continuous suture. The writer employs interrupted silk-worm gut sutures for the purpose, for the reasons already stated. When catgut is used the sutures need not necessarily be removed. When, however, silk-worm gut is used, the sutures are removed on the tenth day following the operation.

Following the primary dressing of the wound, that is, after the first evacuation of feces, the drainage tube and gauze plug need not necessarily be reinserted. If, however, the superficial or sacral wound show evidence of infection at this time, the drainage had best be reintroduced, with the view of draining any infective secretions which may find their way from the retrorectal space into the bowel. If this contingency occur, the rectum must be cleansed daily, using the *Kemp* (Fig. 345) tube, or the anus is distended with a speculum and the site of the wound in the bowel thoroughly cleansed under guidance of the eye. The latter plan is the better. However, in some instances the anus is inflamed and sensitive as the outcome of manipulations in this situation, and the *Kemp* tube may be advantageously used for the purpose.

The rectum is quite intolerant of strong antiseptic solutions. For the purpose of cleansing the wound a saturated (sterile) so-

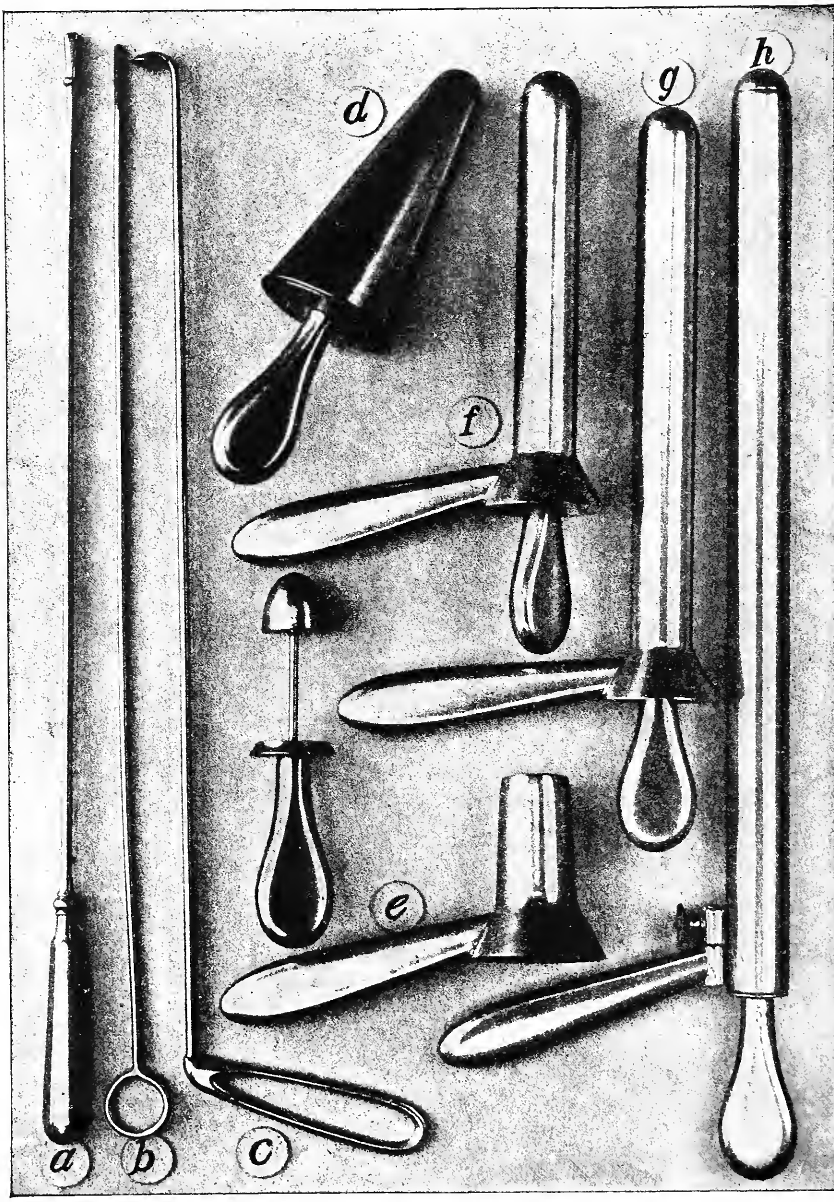


Fig. 342.—*Kelly's* Set of Instruments for Treatment of Wounds of Rectum and Sigmoid. *A*, Sponge-holder; *B*, Applicator; *C*, Curette; *D*, Anal dilator; *E*, Anoscope; *F*, *G*, *H*, Protoscopes. (*Tuttle.*)

lution of boric acid may be used. The solution is introduced into the rectum under very slight pressure when the *Kemp* tube is used, and, of course, need not cause any disturbance whatever when the manipulations are carried on through a speculum.

For the purpose the instruments shown in Fig. 342 will be found very useful. The length of the speculum selected for a given case depends upon the distance from the anus at which union of the divided ends of the gut has been made. It will be found expedient to dilate carefully the anus with the conical dilator (d) shown in the illustration. The introduction of the cylindrical speculum is attended with very little pain, and when the rectum is thus distended cleansing of the parts may be thoroughly and efficiently made. At times a small area of mucosa at the site of union sloughs. This may be removed by using the curette shown in the illustration (c). Collections of pus may be wiped away with a gauze pledget held in the jaws of the sponge holder (a). Applications of tincture of iodin, pure carbolic acid or a solution of nitrate of silver, 60 grains to the ounce, may be made at the site of the wound by means of cotton wound on the applicator (b).

Wounds in the rectum may in this manner be treated in the same way as are wounds more superficially located. The treatment is carried on until healing is complete, which in this situation may require three or four weeks.

The daily introduction of a speculum into the rectum will be found quite distressing, and, indeed, after four or five days following the operation, complete cleansing of the wound need only be made upon each alternate day. For the purpose of cleansing and treating the rectum, the "knee-chest" position will be found to serve best the conditions (Fig. 343). In this position the weight of the abdominal organs is taken entirely off the rectum, and the dilating effect of atmospheric pressure is attained. This position is very useful after convalescence has been established and the need of irrigation no longer obtains, the cleansing of the part being achieved by sponges soaked with a cleansing fluid. In the event of considerable infection being present, and when liberal lavage of the surface is regarded necessary, the patient had best be placed in the *Sims* (Fig. 346) or lithotomy position.

When the *Sims* position is used, the irrigation should be made through a return flow tube (Fig. 346), as the posture does not allow of proper drainage of the cleansing fluid, unless some special provision be made. When the irrigation is used through the

Fig. 343.—Knee-chest Position for Approaching Wound after Resection of the Rectum. (*Tuttle.*)

speculum, the lithotomy position will be found to meet best the indications.

In cases in which an artificial anus is made, the patient is fitted with a pad and abdominal band similar to that worn after colostomy (Fig. 317).

OPERATIONS ON THE ANUS AND THE RECTUM BY THE PERINEAL ROUTE

Operations in this situation present the problem of achieving asepsis under rather unfavorable conditions. It is probable that despite cleanliness, as generally understood in making the toilet, a certain amount of infective bacteria inhabit the hair follicles contiguous to the anus and in the skin of perineum at all times, and that they exist in this situation in greater numbers than obtains in other portions of the body.

The hair, too, in this situation is likely to be abundant, and this contributes to the difficulties as regards cleanliness. It is wise to apply the measures laid down with the view of cleansing the skin in this situation with exactness. The parts had best be shaved several days before the operation, and, if a short growth of hair has appeared at the time of final preparation, the razor should be again employed, and this supplemented with copious application of soap and prolonged lavage.

With regard to catharsis, it would seem best that the bowels should not be moved by medication for twenty-four hours before the operation and cleansing of the rectum and sigmoid be achieved with enemata. For the purpose an enema of soap and water may be given twelve hours before the operation, and six hours later another of acetozone, 1 in 1,000, may be given. No liquid should be introduced into the rectum after this, as it may not be entirely expelled by the time the operation is performed, as the discharge of the residual amount of liquid, together with some feces, is likely to occur as the patient struggles while being narcotized. This latter occurrence is exceedingly disagreeable, and is likely to fertilize the operative field. If there be any doubt as to the lower bowel being empty, a sterile rubber tube of considerable caliber may be passed into the rectum and final discharge of fluids encouraged just before the operation and immediately before the final cleansing of the operative field, when the patient is on the operating table.

However, accidental discharge of fluid from the rectum does at times occur during the operation, and it is wise to have at hand a duplicate set of the necessary instruments, and when soiling of the operative field occurs, these may be made to replace those contaminated.

Also, provision should be made for a second cleansing of the operative field, which is done by an assistant while the surgeon cleanses himself and changes his gown. In this class of cases the wearing of gloves is quite essential, for if soiling occurs it is not attended with as much damage as when the infective material comes in contact with the skin, and it is, of course, a simple matter to remove the soiled gloves and replace them with sterile ones.

During operations of this kind the patient is usually placed in the lithotomy position and the operative field isolated, the arrangement in this regard being quite similar to that employed in gynecological operations, and is described under that head (Fig. 324). except, of course, that the anus is not covered with a sterile towel, as obtains with that class of cases.

The towel is lowered so as to make accessible the anus and, at the same time, obviate contact with non-sterile surfaces by the hands and instruments. At times the lateral *Sims* position is employed (Fig. 346). However, better drainage and greater accessibility is attained by the lithotomy position, unless the operative procedure contemplates attack on the sacrum, in which event the *Sims* position is preferable.

FISTULA IN ANO

Fistula in ano, for which operative relief is undertaken, involves in preparation for surgical attack the question of the character of pathological process. A sufficient number of patients afflicted with fistula in this situation are tuberculous, to warrant thé precautions being taken discussed under the head of tuberculosis in general, and its bearing on operative procedure (page 11). In any event, a search should be made for the avenue of infection, and if this be the lungs or the digestive tract, the patient should be treated in advance with the view of obviating postoperative exacerbation of the distal focus of the tuberculous process. In any event, chloroform narcosis should be employed in preference to that of ether, for reasons already stated. In a certain number of cases an attempt is made to attain primary union of the wound after the fistulous tract has been excised. In this event the postoperative treatment of the wound does not differ from that employed when immediate union of a wound is attempted elsewhere. The bowel is kept quiet with opiates, as already stated, and provision made for the escape of flatus and feces, as described above (page 543).

In the vast majority of instances no attempt at primary union is made, and the wound is packed with gauze with the view of attaining repair by granulation. In these cases the same precautions with respect to keeping quiet the bowel, etc., should be observed, and at the end of forty-eight hours the packing is removed and replaced daily until repair ultimately takes place. When the wound is dressed, the gauze is loosened with hydrogen peroxid, and the line of incision thoroughly cleansed with a solution of corrosive sublimate, 1 in 1,000, or acidi carbolici, 1 in 200.

For the purpose the patient is postured on the bed pan or similar device which allows of prolonged irrigation. Sphinteric control is not usually attained for a week following the operation, and the nurse should be instructed to give an enema two hours before the contemplated visit of the surgeon, and, after the bowels have discharged their contents, to place in contact with the anus a wet dressing of gauze saturated with corrosive sublimate solution, 1 in 1,000, until the attendant arrives, who then packs again the wound with gauze and applies the protective dressing. Catharsis which results in liquid stools should be avoided, unless there be an especial indication for the same.

As already stated, the number of cases in which the fistulæ are tuberculous in origin is quite large, and as these cases do not react readily after operative attack when confined to bed, it is advised that as soon as the immediate effects of the operation are recovered from, the patient be allowed to leave the bed and be placed in the open air. A prolonged convalescence will not infrequently be obviated, if the patient be subjected to over-feeding and the care given cases of tuberculosis generally. The post-operative care of these cases is exceedingly trying, and both the patient and attendant frequently become discouraged. It should be borne in mind that an ultimate favorable outcome is the reward of persistent attention to detail, and that neglect to guide the healing along proper lines may result in failure. For this reason the packing should be carefully and accurately introduced into the wound at each dressing.

It is not uncommon for cases to require six or eight weeks of patient attention to the suggestions offered above before complete repair takes place. Intelligent coöperation on part of the patient is an important determining factor. With a little care, the evacuation of the bowels may be made to take place early in the morning, after breakfast, and the patient may then cleanse the anus with a solution of corrosive sublimate, 1 in 1,000, and as the gauze packing is usually displaced by the action of the sphincter during defecation, a gauze pad may be gently inserted between the buttocks by the patient and held in place with a T-bandage (Fig. 344). He then journeys to the physician's office, who re-

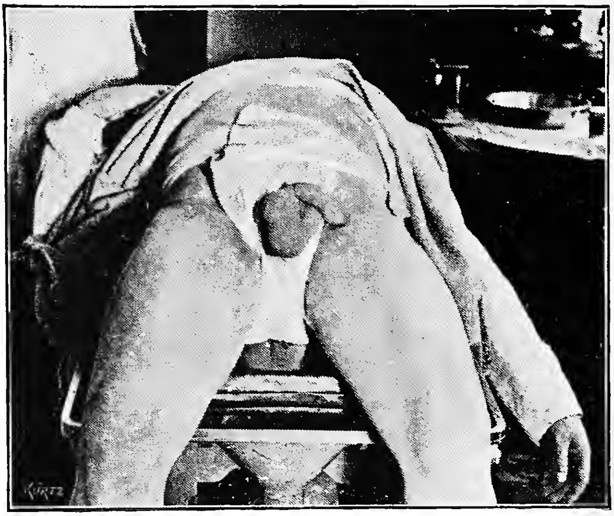


FIG. 344.—T-BANDAGE *in situ*. (*Gerster*.)

packs the wound and applies the protective dressing. While the practitioner need not feel that a failure at relief is necessarily the outcome of disregard of details, it may be said that failure is less likely to occur if they be assiduously carried out.

REMOVAL OF HEMORRHOIDS

The removal of hemorrhoids is preceded by the same preparation as obtain with other operations about the anus (page 548), including the precautions with respect to cleanliness before, during, and after the operation.

In the after-treatment no special measures will be found necessary, except, perhaps, that the pain and tenesmus which follows the operation is more likely to occur following this operation than obtains in instances where the sphincter muscle is divided. The dosage of opiate may have to be somewhat larger for this reason, and the use of cathartics take the place of enemata for the same reason.

As a general rule, considering the thorough cleansing given the lower bowel immediately preceding the operation, no effort need be made to provoke catharsis until the fifth day following the operation and the discharge of feces, when heralded by a desire to defecate may be preceded by removal of the gauze tampon and tube (Fig. 340), in order to facilitate matters, and be followed by cleansing of the wound and reapplication of a protective dressing. The tamponade and tube need not be reintroduced at this sitting. However, if distention with gas and consequent discomfort occur, a sterile rubber tube, well covered with sterile lubricant, may be gently passed into the rectum and left *in situ* until relief is obtained.

During the week succeeding the operation, the diet should be restricted to milk, eggs, broths and lean meats, though, of course, these are not given until postoperative vomiting has ceased.

The period of confinement after the operation depends to some extent upon the method of removal of the pile employed. If the ligature method has been used, the patient should be kept in bed until the ligatures are either absorbed or come away. When granulation is established the patient may leave the bed, but care in cleanliness should be exercised until repair is complete. The clamp and cautery operation is regarded as necessitating confinement for only three days. This is assumed on the ground that the cautery eliminates the danger of infection. This is probably true as regards the operation itself. However, the slough separates finally, and the resultant raw surface is susceptible to the invasion of infection and should be treated accordingly. On the whole, irrespective of the method of excision or removal of piles employed, the patient should be kept quiet until granulation is established and be under the care of the practitioner who employs the necessary cleanliness until repair is complete. It is not improbable that the abscesses and at times fistulæ which occur as sequels to operations for hemorrhoids, will be, in a measure, prevented by exercise of caution in these respects.

Infection of the wound is treated as are infected wounds elsewhere in the body. However, it must be remembered that piles are varicosities of blood-vessels which communicate quite directly with the large venous trunks of the portal system, and that a septic phlebitis in this situation is a menacing occurrence. Early incision and drainage of infected area should be practiced and, if necessary, this should be given the same consideration with regard to the precautions employed in the primary operation.

A chill and sudden rise of temperature, together with the other symptoms of infection, occurring several days after attack upon the veins of the rectum and anus, should be followed at once by dilatation of the anus and search for the offending area. If a black thrombotic area is disclosed at the site of operation, free incision, cleansing, the application of carbolic acid and the introduction of drainage should be employed. If necessary, the patient should be completely narcotized and the manipulations thoroughly carried out. A policy of hesitation may be followed by a septic infection of the veins of the liver and death, a contingency the writer had the misfortune to be confronted with in one instance.

PROLAPSE OF RECTUM, PERINEAL PROTECTOMY, AND EXCISION OF TUMORS FROM THE RECTUM

These operations all contemplate preparations for operation and after-treatment, as indicated above. The special measures following operations for prolapse involve elevation of the foot of the bed for several days after the operation and the avoidance of tenesmus. The latter is controlled by the use of anodynes, as discussed on page 552.

In this connection the cleansing of the rectum by return irrigation through the undilated sphincter, a measure frequently em-

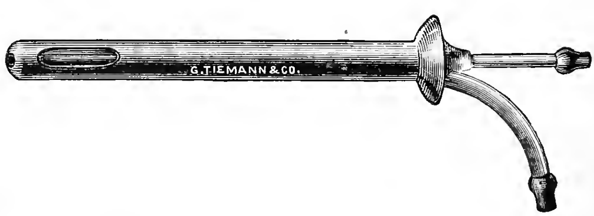


Fig. 345.—*Kemp* Tube for Lavage of Rectum.

ployed following attack of the interior of the rectum, may be taken up. For the purpose the *Kemp* tube is of signal service (Fig. 345). The tube is lubricated and slipped into the rectum, the upper metal tube is connected with the irrigating vessel and the lower connected with a long rubber tube leading into a suitable vessel (Fig. 346). In this way copious lavage of the wound may be made without distention of the rectum, and consequently trauma to the wound surface is obviated. The measure may be

FIG. 346.—CLEANSING RECTUM WITH *Kemp* TUBE. PATIENT IN *Sims'* POSITION. Attendant's fingers constrict outlet tube as indications arise.

repeated several times daily, and its employment requires no special skill. It is especially useful in instances where the lower portion of the rectum has been subjected to operative attack, such as the *Whitehead* operation, partial proctectomy for prolapse, and removal of internal piles by the ligature method.

The flow into the rectum will be quite meager unless the initial amount be held by the finger compressing the outlet tube. The illustration, drawn for the writer by Mr. Nast from life, shows how the fingers may be made to control the amount of fluid permitted to remain in the rectum at one time. When the tube is pinched the rectum is filled and immediate egress occurs when the compression is released.

CHAPTER XXIX

OPERATIONS ON KIDNEY AND URETER

Operations on the kidney: Nephropexy; Nephrotomy; Nephrectomy—Operations on the ureter.

OPERATIONS ON THE KIDNEY

Transperitoneal approach to the kidney involves the same local preparation as obtains with celiotomy, and does not call for repetition here (page 422). Lumbar approach is the method most generally employed. The skin is prepared in the usual way, and the general preparation is in all respects similar to that employed in major operations. Cleansing of the colon should be thoroughly made with the view of obviating the annoyance of having a distended colon persistently encroaching upon the operative field during the manipulations. A collapsed colon shows its peculiar anatomical characteristics much more plainly than does a distended one, the latter being attended at times with obliteration of the longitudinal bands.

In either instance an attempt should be made to cause the urine to be in as physiological a condition as possible at the time the operation is carried out. For the purpose urotropin, methylene blue, sodium benzoate and similar preparations may be administered for several days or a week preceding the operation. In cases of infected kidney some surgeons lavage the pelvis of the kidney daily by means of an uretral catheter for several days before the operation. This is a measure of doubtful utility, as the necessary manipulations require unusual skill and, indeed, even if properly performed, the trauma to the ureter while the lavage is being made is exceedingly liable to cause irritation. In a general way it may be said that an interval of three days should be permitted to succeed instrumentation of the ureter, for any purpose, before the kidney is sectioned.

During lumbar approach to the kidney the patient is postured in a manner to increase the distance between the twelfth rib and the crest of the ilium. For the purpose the patient is placed on the side opposite to the one attacked, and a pad or cushion placed

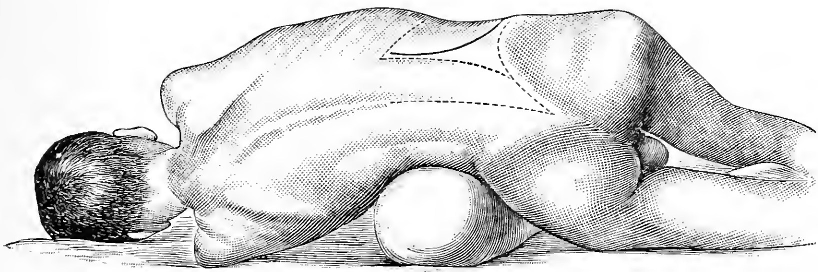


FIG. 347.—PATIENT POSTURED FOR APPROACH TO THE KIDNEY BY THE LUMBAR ROUTE. (*von Bergmann.*)

under the dependent loin. Fig. 347 shows the patient postured in the manner stated. The operating table shown in Fig. 87 has an appliance which allows of attainment of this position with a device which permits of modification of degree of elevation to suit the indications in a given case. When no such apparatus is available an air cushion (Fig. 348), may be advantageously employed, or a blanket rolled on itself to the desired thickness will answer the purpose. Narcosis is not readily administered with the patient in this position, and care must be exercised in this connection, so that respiration be not unnecessarily interfered with.

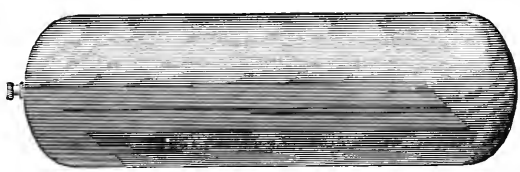


FIG. 348.—*Edebohl's* AIR CUSHION FOR POSTURING PATIENT FOR APPROACH TO KIDNEY.

NEPHROPEXY

Nephropexy is frequently called for on both sides. In these cases the patient is postured in the attitude shown in Fig. 349. The administration of the narcotic becomes still more difficult under these circumstances, and respiration must be carefully observed with the view of altering the position of the patient at intervals, if the necessity arises.

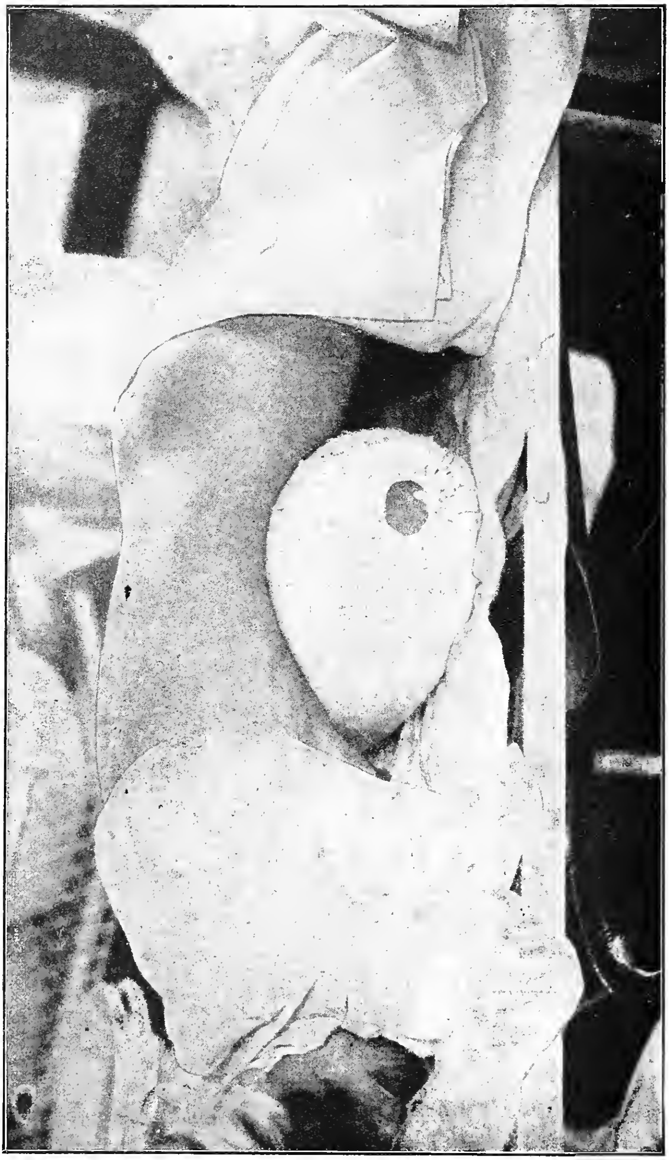


FIG. 349.—PATIENT POSTURED ON AIR CUSHION FOR NEPHROPEXY. (*von Bergmann.*)

Following nephropexy the patient is placed in a bed with its lower portion elevated six inches. This is intended to relieve strain upon the retaining sutures. In some instances the wound about the kidney is packed with the view of causing adherence of the kidney by cicatricial contraction. In either event the position stated should be maintained for a week following the operation, unless some indication to the contrary present. When primary union is aimed at, the dressing is not disturbed until the eighth to tenth day following the operation.

If gauze packing has been employed, the pack is removed on the third day following the operation and fresh gauze introduced. This manipulation is repeated at intervals of forty-eight hours until complete healing takes place.

A small quantity of blood is at times present in the urine following nephropexy, especially if the kidney capsule has been sectioned and its flaps employed in the fixation. Hematuria follows in instances in which the kidney capsule has not been invaded, this no doubt being due to the trauma of the kidney tissue which results in sufficient contusion to cause the bleeding. The symptom is of no great import, except in instances in which the bleeding is sufficient to form a clot and the passage of clots through the ureter is accompanied by symptoms quite typical of renal colic. As a rule the administration of an opiate will control the pain. When kidney colic follows nephropexy diuretics had best not be given in large quantity. The pressure from the urine behind the clot causes much pain, and it is best to permit the clots to pass into the bladder under slight pressure. When the clots reach the bladder there may be some tenesmus and sudden arrest of urinary discharge from the urethra, the outcome of mechanical obstruction. This is usually not severe, and the bladder symptoms promptly disappear when the clots are passed. Clots from the kidney are usually long and narrow, and are not of sufficient size to necessitate removal by bladder lavage. However, if the bladder symptoms persist, a copious lavage of that organ with warm boric acid solution through a roomy catheter will effect removal of the offending agents. On the whole, instrumentation of the bladder for removal of clots from the kidney should be avoided if feasible, as infection finds an exceedingly favorable condition of affairs for development under the circumstances.

Patients should be confined to bed for two weeks following nephropexy, at the end of which time a proper abdominal supporter (Fig. 300) or corset (Fig. 302) should be worn for several months. More especially is the wearing of supporting appliances indicated, as floating kidney is usually a part of a more or less general enteroptosis.

NEPHROTOMY

Nephrotomy is invariably followed by drainage. When abscess is present, tube drainage is commonly employed, and the perinephritic area drained with gauze. When the operation contemplates only removal of a calculus without coexisting infection, gauze drainage alone will suffice the indications. In the former event (of abscess), the tube drain is left *in situ* until the superficial wound is freely granulating, and the latter is cleansed and repacked every alternate day until these conditions obtain. In this way an avenue of exit for the discharge of infective secretions together with the urine which does not find its way at once into the normal passages is furnished, and the occurrence of the infiltration of the postperitoneal tissue is obviated. If the drainage is interfered with, the secretions accumulate in the perirenal tissue, infiltrate the subserous fat and the connective tissue in the region of the kidney, at times invading the pelvis and pointing anteriorly over the pubis in the space of *Retzius*. The tube drainage should not be discarded until the discharge from the cavity is seropurulent or serous, when the tubes may be removed and silk-worm gut or horsehair drainage (Figs. 147 and 149), substituted, until final repair takes place. If for any reason retention of inflammatory exudates occur during the after-treatment, the condition is met along the lines usually employed with abscess, *i.e.,* incision and drainage.

Renal colic with its characteristic symptoms follows nephrotomy, in some cases as the result of the passage of blood clots or inflammatory exudate through the ureter. Its occurrence has been taken up under the head of nephropexy (page 559). Patients afflicted in this way are apt to be discouraged when this occurs, on the ground that they believe the object of the operation has not been achieved, indeed the practitioner may conceive the same notion. The discovery of blood clots in the urine will soon dissipate this idea. Colic is most likely to follow nephrotomy when the kidney has been made the subject of attack close to or at the renal pelvis.

Urinary fistula logically is more commonly a sequel to nephrotomy than obtains with nephrectomy, although in rare instances urinary fistula has occurred sequentially to nephrectomy when the ureter has been removed low down, the urine from the opposite kidney damming up in the bladder and forcing its way through the stump of the ureter and into the nephrectomy wound, forming an infiltrate which after discharge leaves a fistulous tract opening on the skin which intermittently discharges urine. The discharge of urine from the lumbar wound after nephrotomy does not necessarily mean that the ureter is obstructed. It may be the result of the discharge of urine into the cavity which has been drained externally from the walls, which are made up of functionating kidney parechyma. Under these circumstances the urine naturally goes in the direction of least resistance, and this is toward the skin. When repair of the cavity takes place, the urine, in the majority of instances, takes its normal route of exit through the ureter, as the drainage opening grows smaller and ultimately the fistula heals. When the fistula is established, the wound should be dressed once or possibly twice daily according to the amount of urine discharged through the external opening, and the skin surrounding the wound must be kept clean. The contiguous skin should be coated with an ointment consisting of sterile vaseline and aristol. This acts largely mechanically and prevents irritation.

When the discharge of urine from the fistula becomes slight, and, judging from the total quantity of urine passed by the normal route, it is a fair inference that the ureter on the sectioned side is patent, tincture of iodin may be injected into the fistulous tract, with the view of stimulating repair by a reactionary inflammatory proliferation of connective tissue. If there be any doubt as to the reëstablishment of the flow of urine into the bladder on that side, cystoscopy, after methylene blue has been given, may aid in determining whether urine comes from the afflicted side.

If a permanent or persistent fistula is established and the discharge of urine from the tract is sufficient in quantity, a urinal may be worn which permits the patient to go about with little inconvenience (Fig. 350). The question of operative attempt to reëstablish the normal course of the urine or the question of nephrectomy are not properly discussed here. In a general way, it may be said that the wearing of an apparatus, as indicated, will permit the patient to go about and regain his general health, fitting him better for subsequent surgical manipulations.

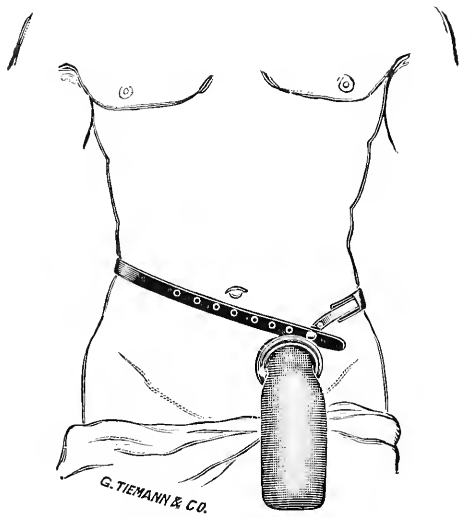


Fig. 350. — Urinal Worn by Patient with Urinary Fistula. This apparatus will be found serviceable irrespective of location of fistula.

NEPHRECTOMY

Nephrectomy is followed by much the same local treatment employed after nephrotomy. In the absence of infection, the wound is quite closed by suture and drainage from its dependent portion is made. For the purpose the material discussed above (page 189) is employed. The selection between tube, textile fabric, or capillary drainage depends upon the character and magnitude of the affliction for which nephrectomy is made. When suppuration is present tube drainage should be employed for at least five days after the enucleation. Textile fabric drainage may then be substituted, and when there has been much oozing and considerable trauma to the contiguous soft parts, the cigarette drain (Fig. 154) may be used. Drainage with strands of silk-worm gut or horsehair may be employed when the discharges become moderate in quantity.

Uremia is a menace of some import following nephrectomy. It may follow nephrotomy, but is less likely to occur after the latter operation than with the former, for obvious reasons. The quantity of urine excreted after nephrectomy should be carefully recorded, and a quantitative analysis of the proportion of solids should be made. In all cases free catharsis should be employed as soon as the postoperative vomiting is controlled, with the view of eliminating a portion of the end products of metabolism by the bowel. As soon as it becomes manifest that the remaining kidney is not capable of eliminating the necessary amount of urea, the skin should be used for the purpose by encouraging perspiration. The patient is caused to perspire by the administration of pilocarpine gr. one-sixth hypodermatically every four hours, and the methods of provoking perspiration by heat should be employed. Dry heat is preferable to moist heat, the former being better borne by the patient. Vomiting should not be discouraged after it becomes manifest that the stomach is eliminating urea, and the catharsis may be produced by colic lavage.

In most instances the kidney excretion is lessened after a major operation of any kind, partly as the outcome of shock and in part because of the narcosis. Undue meddlesomeness should not be indulged in. Persistent vomiting should arouse suspicion with respect to uremia. Diruetics should not be indiscriminately employed. The remaining kidney is already overburdened with work, and an additional tax upon it should be avoided. The general principle of meeting the indication is to use the various channels of elimination until such time as a physiological balance is established. In most instances this is soon attained, and the prognosis, with due care in the way stated, is not particularly unfavorable. For some considerable time the diet of the patient should contemplate avoidance of large quantities of nitrogenized food, with the view of lessening the labor of the remaining kidney. Urinary fistula following nephrectomy is taken up above (page 561).

Peritonitis follows extra-peritoneal nephrectomy in some instances; its consequences, such as intestinal obstruction, mechanical and otherwise, is already taken up; its treatment is in no respect different than when it is a complication subsequent to celiotomy (page 451). Permanent removal of drainage agents, removal of sutures, and the indications for change of dressing are similar to those already taken up under the general considerations of these questions.

OPERATIONS ON THE URETER

When the ureter is attacked by the transperitoneal route, the preparation of the patient and the after-treatment as regards the part the peritoneal sac always plays in these problems, are the same as obtain with celiotomy, and are described under that head (page 422).

The extra-peritoneal method of approach is the one most commonly employed in this class of cases.

The position of the patient is that of the lateral semi-prone posture, the abdomen being slightly turned toward the table. The cushion or similar device employed during the approach to the kidney is not of service in this connection, as it prevents the intestine from dropping forward and away from the operative field. Operations involving invasion of the ureter are invariably followed by drainage. The same general rules with respect to the change of dressings, the kind of drainage material best suited for the purpose, etc., apply in this situation as are applicable to the kidney (page 560).

Urinary fistula is also taken care of in the manner stated in connection with operations on the kidney. When infection already exists at the time of the operation, tube drainage is employed until the character of the discharged secretions becomes serous or seropurulent. When the ureter is implanted into the skin, the wound must be cleansed twice daily and the measures related above assiduously carried out.

Interference with drainage and free discharge of urine will stand in a causative relationship to inflammatory infiltration, extravasation of urine and formation of abscess, septicemia and the like as obtains from this cause in connection with operations on the kidney. This may, however, be said as regards ureteral obstruction, that if the kidney is functionating, arrest of the free discharge of urine is followed more certainly by the complications mentioned than attends with attack upon the kidney in instances where the ureter is patent. This should be borne in mind, and the patency of the avenue of drainage must be carefully conserved.

Grafting of the ureter into the bladder should be followed by drainage of the bladder itself. Distention of the urinary bladder following plastic anastomosis subjects the line of suture to strain, and may result in separation of the parts. For the purpose the bladder is drained with a retention catheter (Fig. 354). If lavage of the bladder is regarded as indicated during the first five or six days following the operation, the measure must be carefuly carried out, no more than three ounces of cleansing fluid being introduced at a time, and the bladder be allowed to empty itself before additional fluid is injected. Distention of the bladder is best avoided by the return flow attachment described above (page 538). However, it must be remembered that the outward flow is not as rapid as that of entrance, and the same precaution with regard to the quantity introduced at a time must be observed, as attends the manipulation when only a single tube is employed for the purpose. In cases of this sort the wound of approach is also drained in the manner stated above, with the view of taking care of any leakage which may occur. This fact should, however, not engender disregard of the precautions discussed in connection with bladder drainage.

CHAPTER XXX

OPERATIONS ON THE BLADDER AND PROSTATE GLAND

Operations on the bladder: Suprapubic cystotomy; Temporary suprapubic drainage; Permanent suprapubic drainage following cystotomy—Perineal prostatectomy.

OPERATIONS ON THE BLADDER

SUPRAPUBIC CYSTOTOMY

Suprapubic invasion of the bladder does not mean opening of the peritoneal sac in the majority of instances. However, the relationship the peritoneum bears to the space of *Retzius* is not by any means typical, and accidental invasion of this membrane may occur. Again, a certain number of operations made upon the bladder contemplate peritoneal invasion. For these reasons operations of this sort should be preceded by the same preparation, both general and local, employed for celiotomy, and the *Trendelenburg* posture during the operation should be provided for.

In addition to this, the bladder should be lavaged for several days before the operation with the view of cleansing the mucosa. In many instances the mucosa is already infected at the time of the operative attack, and this should be treated as such for a period of time as seems permissible in view of the conditions present calling for operative relief. For the purpose a solution of potassium permanganate, 1 in 1,000, may be employed. Urotropin in doses of ten grains three times daily may be given for several days before the operation, with the view of contributing to the desired end.

Immediately before the operation the bladder is distended with ten or twelve ounces of sterile saline solution, in order to increase the extra-peritoneal area of the bladder above the pubic bones. If infection be markedly present at the time of the operation, the bladder may be thoroughly lavaged with the potassium permanganate solution just previous to section, and this replaced with saline solution before the operation is begun.

TEMPORARY SUPRAPUBIC DRAINAGE

Temporary suprapubic drainage of the bladder is established following opening of the bladder in this situation. This is true whether the section has been made for the removal of stone, tumors, or for prostatectomy. For the purpose the bladder wall is inverted around a rubber catheter, which in turn is connected with an appropriate vessel by means of a long tube. As the angle at which the drainage tube enters the bladder is that of about 90 degrees to the body, the tube is likely to kink and become obliterated. In addition to this, the elasticity of the bent tube makes tension on the sutures, objections which should be overcome. For the purpose it is best to use an angular catheter (Fig. 351). The intravesical portion may be made shorter as the con-

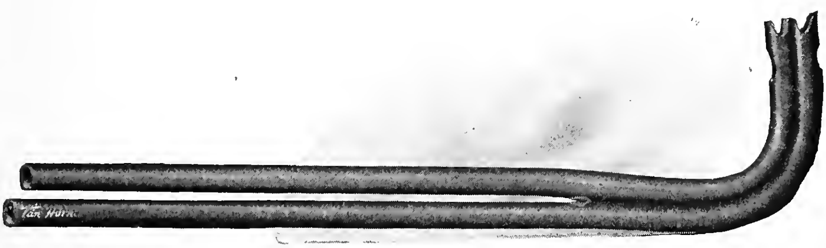


Fig. 351.—Angular "Double Flow" Soft Catheter for Suprapubic Drainage of Bladder.

ditions present, so that when introduced the angle of the device is a little above the level of the skin. The bladder may be lavaged through one tube, and the fluid flows out through the other, though care must be exercised not to inject a sufficient quantity of fluid to bring strain upon the sutures.

To obviate the latter contingency and, indeed, to remove the objections mentioned in all respects, suprapubic drainage of the bladder may be made by means of the device shown in

Fig. 352. The largest tube drains the bladder, and the angular attachment, the glass tube, is connected with a longer one draining in-

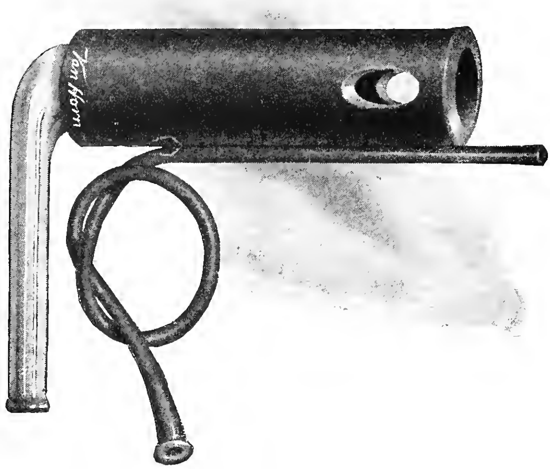


Fig. 352.—*Marion* Soft Rubber Apparatus for Drainage and Cleansing of the Bladder Following Suprapubic Prostatectomy.

to a vessel (Fig. 353). Cleansing solutions may be introduced into the bladder through the small catheter, which is furnished with a

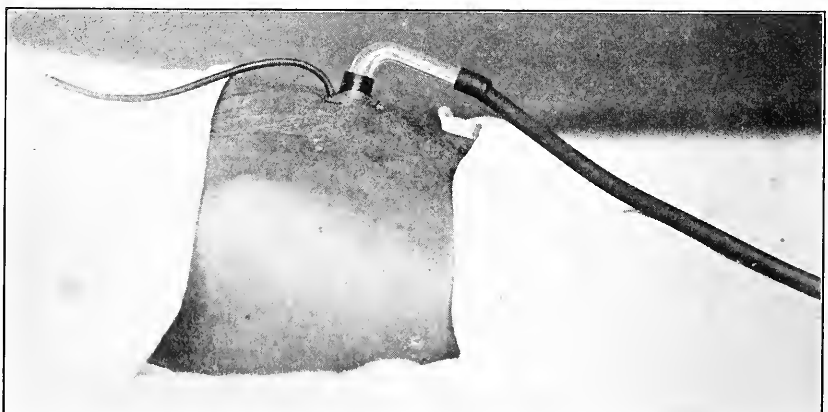


Fig. 353.—Apparatus for Drainage and Cleansing of Bladder (shown in Fig. 352) *in situ*. The cleansing fluid is injected into the smaller tube and finds ready egress through the larger one.

wide mouth to permit of easy access of the nozzle of a syringe. The large drainage tube permits of exit of the cleansing fluid so readily that deleterious distention of the bladder becomes quite impossible. Between the intervals of treatment the smaller catheter is clamped. The question of drainage of the bladder through the urethra as supplementary to suprapubic drainage may be taken up here. It may be said that, as a rule, suprapubic drainage meets the indications. However, in some instances, especially where the bladder is severely infected, there is no objection to the additional use of dependent drainage. For this purpose the retention catheter shown in Figs. 354, 355 and 356 may be used Fig. 354 shows the mushroom retention catheter. The enlarge-

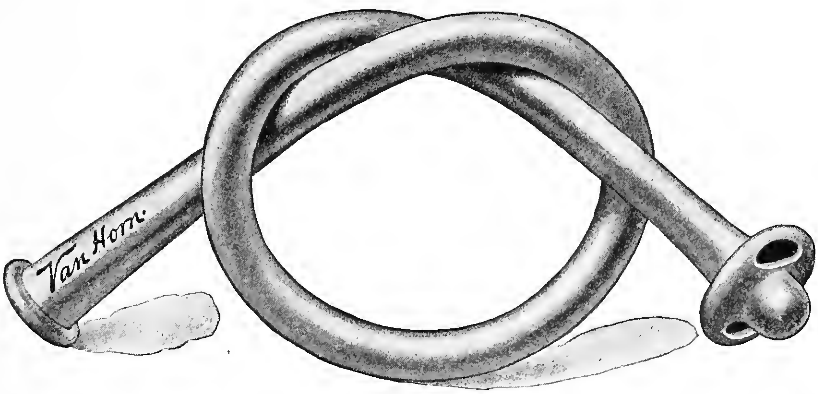


FIG. 354.—MUSHROOM RETENTION CATHETER FOR DRAINAGE OF THE BLADDER *per urethram.*

ment near the tip is engaged beyond the neck of the bladder and effectually prevents its expulsion. When the catheter is introduced, the mushroom enlargement is obliterated by inserting into its lumen the stylet (Fig. 355), which is curved to conform to

FIG. 355.—SPECIALLY CONSTRUCTED STYLET FOR INTRODUCTION OF MUSHROOM CATHETER.

the shape of the ordinary steel sound. The distal end of the catheter is held by the loop of the handle of the stylet and the degree of tension employed is sufficient to obliterate the mushroom (Fig. 356) to a sufficient extent to make insertion of the catheter into the bladder an easy matter. When the stylet is withdrawn, the catheter reassumes its original form.

In these instances lavage is accomplished by washing through and through in either direction, though on general principles the injection should be made suprapubically and the urethral drain be made to evacuate the contents of the bladder.

FIG. 356.—MUSHROOM CATHETER DRAWN OVER STYLET OBLITERATING DISTAL WIDENING TO FACILITATE INTRODUCTION INTO BLADDER.

Following the removal of neoplasms, foreign bodies or stone, drainage need not be employed for more than six days. At the end of this time the tube is removed and the bladder catheterized, at first every six hours and later every eight hours. Before each catheterization the patient is instructed to attempt to void spontaneously the urine, and failing in this the catheter is used. In all instances, even though spontaneous discharge of urine occur, the bladder should be catheterized and lavaged once daily until all evidence of inflammatory exudate disappears. Prolonged drainage of the bladder results in lack of control of the function of urination, and this should be obviated in the manner stated. The valvular arrangement of the bladder wall surrounding the catheter is regarded as preventing leakage when the suprapubic drain is removed. Unfortunately this does not obtain in all instances. While leakage does not always occur when the patient is quiescent, efforts at urination are usually attended with the discharge of a certain amount of urine through the suprapubic wound. When the patient attempts to pass the urine by way of the urethra, the wound should be exposed and the patient postured on the bed pan or similar device. The urine which leaks from the wound is thus discharged into a proper receptacle, rather than allowed to saturate the dressing. The wound is cleansed and redressed subsequent to each urination until leakage no longer occurs. In this way infiltration of the tissues contiguous to the wound is avoided and secondary infection is also obviated.

The superficial suprapubic wound is usually approximated with silk-worm gut sutures, and these are left *in situ* for ten days, unless infection of the cellular tissue beneath require their earlier removal. If this occurs, the lower sutures may be removed, drainage established, and the wound lightly packed with gauze. The upper sutures, *i.e.,* those above the point of exit of the bladder drain, do not usually require removal, and their maintenance in place contributes much to the ultimate complete repair.

Following suprapubic prostatectomy the drainage is left in place as long as there is any foul urine. In some instances this requires weeks of time. The cleansing of the site of removal of the gland is quite essential, and should be made several times daily. Small areas of tissue frequently undergo sloughing at the site of the deep wound, and their removal is much facilitated by the employment of the apparatus shown in Fig. 352. Patients who have been subjected to suprapubic removal of the prostate gland are not kept in bed longer than the time required for recovery from the narcosis, but are placed in the sitting position at this time. The care of the intravesical portion of the drainage apparatus is taken up more largely under perineal prostatectomy (page 573).

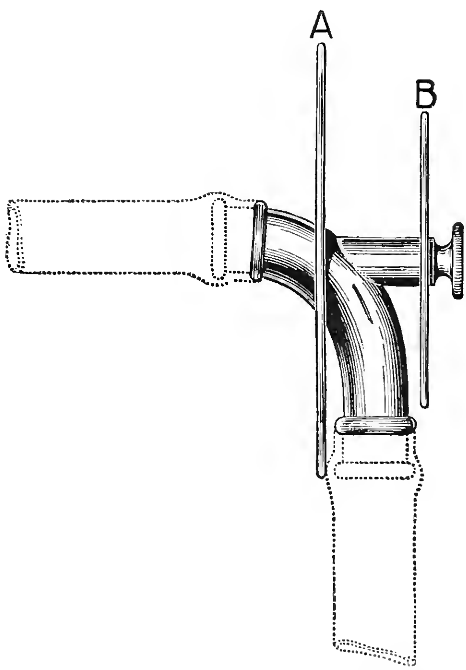


Fig. 357.—Permanent Suprapubic Drainage Tube. *A,* Plate fitting against abdomen; *B,* Plate to go inside belt; *C,* Rubber tube into bladder; *D,* Rubber tube to urinal. (*Keyes.*)

PERMANENT SUPRAPUBIC DRAINAGE FOLLOWING CYSTOTOMY

This measure is employed in instances where there is an impermeable obstruction to the egress of urine or in cases of uncontrollable cystitis after drainage for several days has been

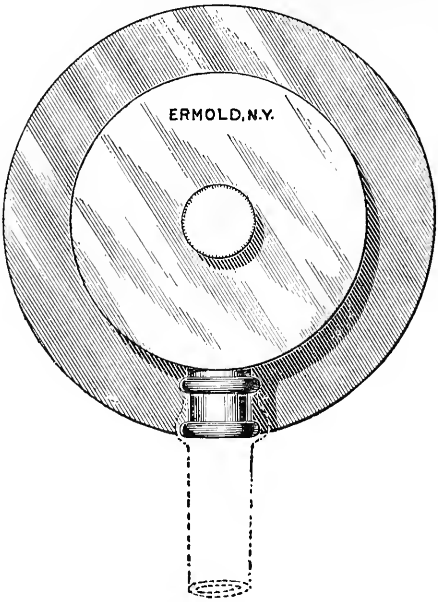


FIG. 358.—FRONT VIEW OF APPARATUS FOR PERMANENT SUPRAPUBIC DRAINAGE OF BLADDER. (*Keyes.*)

made, as described under temporary bladder drainage. The apparatus found most useful in these cases is shown in Figs. 357 and 358. Fig. 357 shows a lateral view of the appliance.

It is made of silver and hard rubber. The tube must be of sufficient caliber to carry off thick mucus and clots. A short rubber drainage tube is slipped over the exteremity A, and this is introduced through the fistula into the bladder. The tube is held in place by a home-made washable belt passing outside the smaller disk (not between the two), and tight enough to press the inner disk firmly against the skin, so that no urine can escape outside of the tube. Continuous drainage may be maintained by attaching the outer side of the tube to a leg urinal (Fig. 359). If the bladder will tolerate a little fluid, it is more convenient to cork the tube and allow "hypogastric urination" at stated intervals. (*Keyes.*)

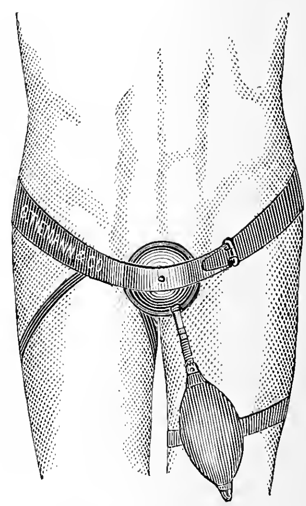


FIG. 359.—LEG URINAL USED IN CONJUNCTION WITH PERMANENT SUPRAPUBIC DRAINAGE APPARATUS. (*Keyes.*)

If the measure is used for cystitis through and through, lavage can be practiced by the introduction of a catheter through the uretha. Lavage may be made through the suprapubic opening. The rubber tube within the bladder must be changed every twenty-four hours and a clean one substituted. The fistula itself, together with the surrounding skin, should be cleansed daily, at the time the intravesical portion of the drainage apparatus is changed. For the purpose a mild solution of potassium permanganate or similar preparation may be employed. The skin surrounding the wound may be dusted with an antiseptic powder. Those devoid of odor are, of course, to be used for obvious reasons. If at any time the use of the apparatus is no longer necessary, the fistula heals very rapidly.

PERINEAL PROSTATECTOMY

The preparation of the patient for perineal prostatectomy should contemplate cleansing of the bladder for several days before the operation. Sufficient enlargement of the prostate gland to justify its removal also causes retention of residual urine, decomposition of the urine and infection of the bladder. The protracted use of the catheter, as has, indeed, usually preceded the attempt at operative relief, together with the factors mentioned, produce a condition of chronic inflammation in the bladder mucosa which makes sterilization of this membrane practically impossible. However, persistent lavage, such as is described in connection with the care of postoperative cystitis (page 537), will lessen markedly the degree of infection, and is a measure well worth employment, provided the condition of the patient warrant the delay. Cleansing of the bladder preliminary to its invasion has already been taken up (page 566). The measure is perhaps of greater necessity in connection with enucleation of the prostate gland than obtains in any other condition. The administration of urinary antiseptics, such as urotropin, is usually employed by the practitioner for a considerable period of time before the case is subjected to operative attack. However, an increase of dosage for several days before the operation is at times advisable.

Prostatic hypertrophy is essentially an affliction of advanced life. The precautions taken up under general considerations should be applied in this class of cases. Albuminuria, diabetes, arterial sclerosis and cardiac disease all call for special management in this connection. The administration of the potassium iodid for a week before the operation, under the restrictions already stated, is a measure of seeming utility.

The local preparation of the perineum is already taken up (page 548). Cleansing of the rectum, too, should receive special attention. It is not infrequently necessary to introduce the finger into the rectum during the operative manipulations, and this organ should be cleansed and the precautions with respect to avoiding the presence of liquids in the rectum, previously stated, should be taken (page 549). At times it is necessary to section the abdomen during the operation. Therefore the pubis should be shaved and, indeed, the abdominal wall cleansed as for celiotomy.

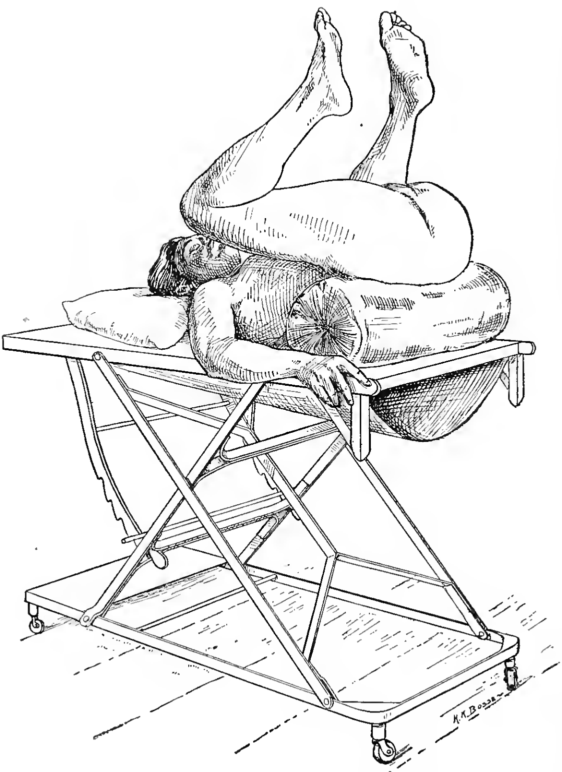


FIG. 360.—PATIENT IN EXAGGERATED LITHOTOMY POSITION. (*Bryant.*)

The position of the patient during the operation is an important factor with respect to the accessibility of the parts. It has been found most expedient to posture the patient in the exaggerated lithotomy position (Fig. 360). The leg-holders usually employed during operations in this region are dispensed with, and the lower limbs are held in the position indicated in the illustration, either by the assistants or by means of a folded sheet or similar device which draws the knees toward the thorax. The pressure of the limbs against the chest and abdomen interferes with respiration, and it is at intervals necessary to lower the thighs to afford relief. It would seem expedient not to fasten the legs firmly in the position mentioned, but to have them held by assistants, so that the necessary modification of attitude may be promptly attained. It is to be borne in mind that narcosis is, at best, not well borne by elderly persons, and that difficulties in this connection are likely to suddenly arise.

When the enucleation is completed, drainage is provided for in all instances. When the section has been made in the median line, the tube drain is surrounded by an umbrella or chemise

FIG. 361.—CHEMISE CANNULA. (*Bryant.*)

packing. Fig. 361 shows a cannula which is very useful for the purpose, the openings at the distal end being used to fasten tapes which are tied about the body. However, an ordinary catheter arranged in the way shown in Fig. 362 will answer the purpose very well, or the "mushroom" retention catheter (Fig. 354) may be used. The drain is inserted into the perineal wound to the desired extent, and the "chemise" is packed with strips of gauze in much the same manner as is done in connection with the *Mikulicz* tamponade. When the crescentric approach to the gland is employed, the drain is brought out at the side of the wound

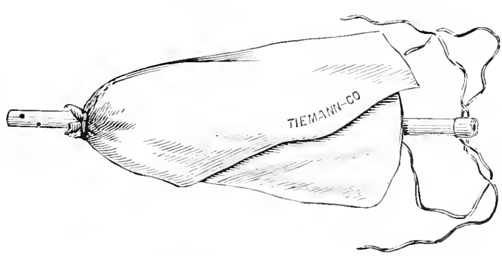


FIG. 362.—CHEMISE CATHETER. (*Bryant.*)

(Fig. 363). In either instance the drain is connected with a long rubber tube by means of a glass connection and the latter is led into a vessel.

The bladder is lavaged twice daily, employing a solution of

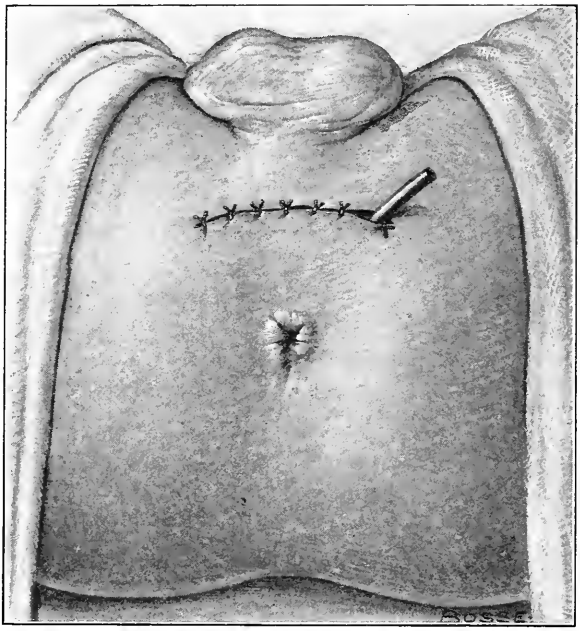


FIG. 363.—LATERAL DRAINAGE OF BLADDER AFTER CRESCENTRIC APPROACH TO PROSTATE GLAND.

potassium permanganate, 1 in 1,000, for the purpose. Carbolic acid or corrosive sublimate should not be used except that, perhaps, in cases of severe infection the former may be used at considerable intervals, and only in moderate strength (1 in 250). The packing should be removed at the end of forty-eight hours and is not renewed, being only employed with the view of controlling bleeding. When the crescentric approach is made, packing is usually not introduced. The drain is affixed to the edge of the wound by a catgut stitch, and the wound closed with interrupted silk-worm gut sutures. Most surgeons of wide experience place the patient in the sitting posture as soon as the effects of the narcosis have disappeared. This would seem rational in view of the fact that drainage is best conserved in this way and, also, that elderly persons develop very readily a low grade of pneumonia when confined to bed. It must be borne in mind, however, that persons advanced in life are likely to be afflicted with changes in the cardiac muscular fiber, and that the shock of so severe a measure as prostatectomy is liable to be considerable. The pulse rate, respiration and general appearance of the patient must be taken into account before the mechanical factors in the problem are given precedence. The patient had best be supported by pillows, and the position carefully changed without any exertion on part of the patient for two days following the operation, and the effect of a change of posture upon the pulse-rate noted with the view of being guided as to the propriety of allowing of additional effort. The tube is left *in situ* for a week, that is, perineal drainage of the bladder is maintained for that period of time, the tube being removed once daily and a sterile one inserted in its place. Some surgeons remove the perineal drain at the end of forty-eight hours, believing that all necessary egress of urine or inflammatory exudate will occur through the wound, and that the retention of tube drainage in the neck of the bladder for a protracted period of time lengthens the time before voluntary control of micturition obtains. The latter proposition is, of course, true. However, on the whole, it is best to drain the bladder until the danger of infection and infiltration of the tissues of the perineum is past. If the tube is removed early, the bladder must be catheterized twice daily through the perineal wound. There are some cases in which tenesmus is so marked that retention of the drain is impracticable despite the administration of antispasmodics, and in these instances the measure just mentioned becomes imperative.

After the immediate symptoms following the operation have disappeared the patient should be postured on the side of the bed with a *Kelly* pad (Fig. 13) under the buttocks in a good light and the bladder thoroughly lavaged, a clean tube introduced, and a fresh dressing applied. This measure should be thoroughly and carefully carried out once daily. As soon as the patient is able to be about, the measure may be carried out on the table and, indeed, this is advisable, giving as it does a condition of affairs which conserves thoroughness. At the end of a week a full-sized sound is passed into the bladder, *per urethram*, and the drainage in the perineum is abolished. The perineal wound is now lightly packed with gauze, held in place by means of a T-bandage. The patient is instructed to make an effort to pass the urine spontaneously every three hours, irrespective of whether he has any desire to do so or not. This may obviate retention of urine, the outcome of distention of a diseased bladder. The urine, of course, escapes by way of the perineum, and so the patient must micturate while seated over a proper receptacle. Also, the urine leaking into the gauze causes the perineal wound to be irritated and the latter must be cleansed twice daily.

At first most of the urine is passed through the perineal wound, but gradually a little, and later more and more, of the urine passes by way of the urethra, and ultimately the perineal wound closes and all the urine passes the natural way. During all this time close attention must be paid to cleanliness, both of the perineal wound and the bladder. Cystitis, the outcome of prostatic disease, rarely disappears entirely, a small quantity of pus being found in the urine after the most successful cases. This does not mean that instrumentation and lavage of the bladder and urethra should be carried on indefinitely. On the contrary, the less instrumentation of the parts there be after prostatectomy the better. It may be said that small quantities of pus and no clinical evidence of cystitis is best not meddled with.

On the other hand, cystitis with frequency of urination and tenesmus persists after prostatectomy for a considerable period of time in a certain number of cases, and this condition should be treated in the way cystitis is treated generally. Urinary antiseptics, such as urotropin, may be given for a long time following the operation. A plan worth following is to administer five grains of urotropin three times daily for a week, and then intermit the medication for a week, soon after convalescence is established. Later on an occasional use of an urinary antiseptic may be indulged in.

The passage of sounds is employed every five days until the perineal wound is closed, after which a sound is passed every two weeks for three months. Later than this the passage of a sound is not employed, except for special reasons. A chemical and microscopical examination of the urine should be made every month.

CHAPTER XXXI

OPERATIONS ON THE SCROTUM AND PENIS

Hydrocele—Castration—Varicocele—Circumcision—Plastic operations on the penis—Urethrotomy for stricture.

HYDROCELE

Hydrocele, if treated by the open method with suture of the edges of the sac to the skin and subsequent packing of the cavity, contemplates obliteration of the tunica by granulation repair. Fig. 364 shows the appearance of the parts after operation. The original packing is left in place for two days, when it is removed, the cavity irrigated with a corrosive sublimate solution, 1 in 2,000, and the packing renewed. This procedure must be repeated at intervals of forty-eight hours until healing by granulation, from within outward, is accomplished. The sutures, if they be of a non-absorbable material (which is preferable), are removed on the tenth day following the operation. The patient need not be confined to bed after the fourth day following the operation, and may be permitted to go about with the dressing held in place by means of an ordinary suspensory bandage after the sutures are removed (the tenth day). Complete healing does not usually occur until three weeks after the operation. If the hydrocele be entirely excised, the wound is treated in all respects similarly to wounds in other portions of the body where primary union is

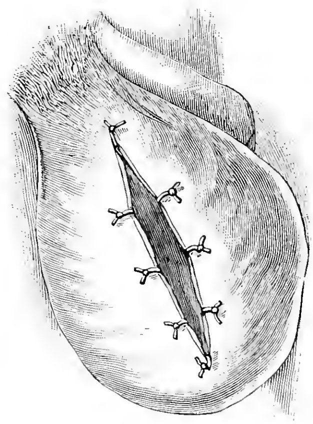


Fig. 364.—Appearance of Wound after Incision for Hydrocele (*Volkmann's* Method). (*Bryant.*)

aimed at. It is worth bearing in mind, however, that the dartos is liable to undergo considerable modification of area, the result of its contractility, and that undue strain upon the suture line for four days after the operation is to be prevented. For this reason the patient should be confined to bed for four days after the operation, as is advised in connection with the open operation, and should not be permitted to go about until after the sutures are removed, which in this instance may be done on the tenth day following the operation. If infection occur, the wound is treated by drainage and light packing, as is described in connection with the care of infected wounds generally (page 305).

CASTRATION

Castration, if done for malignant disease, is followed by complete closure of the wound of approach and subsequent local care similar to that of relief of hydrocele by the excision method. Oozing and arterial bleeding at times follow the operation, distending the scrotum in the manner described under varicocele. The complication is met by reopening of the wound and ligature of the bleeding point or points. The time of removal of sutures and the length of time of confinement is similar to that applied to hydrocele. The operation of double castration, unless performed late in life (how late is difficult to say), is followed by a mental depression which calls for the exercise of considerable tact, and perhaps justifiable deceit with regard to the sexual function.

VARICOCELE

Varicocele presents much the same problem with respect to after-treatment as obtains in the conditions just discussed. As a rule, the wound is entirely closed without drainage. It is, however, wise to permit a small drain to remain in the inferior angle of the wound for several days after the operation, in order to give opportunity for the discharge of blood, the outcome of a recurrence of oozing, which is not, in all cases, apparent at the time of the operation. For the purpose a few strands of silk-worm gut may be used (Fig. 147), which are removed on the third day following the operation. When drainage is omitted, the tunica becomes distended with blood, which at times causes the formation of a large tumor, and an infiltration of the subcutaneous tissue upon the abdomen over the penis and down the thigh. When the bleeding persists, the distention extends into the inguinal canal, making pressure on the cord and testicle which gives rise to considerable pain. Fig. 365 shows a case of this sort. The patient

Fig. 365.—Infiltration of Tunica, Scrotum and Penis with Blood following Operation for Relief of Varicocele.

had an unusually extensive venous dilatation, the operative procedure involving considerable trauma to the adjacent tissues in order to accomplish the purpose. The wound was reopened, the clots removed, and drainage established. The case illustrated the lessened coagulability of the blood, as the patient had just recovered from an attack of jaundice due to gastroduodonitis. There was a considerable amount of oozing for some days after the operation, and convalescence was exceedingly protracted.

Reopening of the wound and removal of the blood should not be postponed too long, as in some instances pressure, necrosis, and sloughing of the testicle have occurred as the outcome of delay.

After the wound has been reopened, the local conditions are exceedingly favorable to the invasion of infection. Great care should be exercised to obviate this occurrence. The contiguity of the wound to the penis makes it difficult to maintain dry asepsis, and for this reason a wet dressing of carbolic acid, 1 in 200, in sterile water should be applied. However, this should be kept in contact with the wound only during the day, and be replaced with a sterile dressing during the night, to obviate the sloughing and maceration of the skin consequent to the prolonged application of carbolic acid. The wound should be scrutinized daily, and any accumulation of secretion carefully and gently expressed from the scrotum. The patient must be kept confined until granulation is well established.

CIRCUMCISION

As circumcision is usually done under local anesthesia, the tissues are infiltrated and distended, and should for this reason be apposed with sutures that do not cause tension. Horsehair or fine silk-worm gut are most serviceable for the purpose. The penis is dressed by loosely applying very soft gauze, which is wound about the penis and held in place with a T-bandage, the gauze being fastened to the later by means of a safety pin (Fig. 366). The operation is usually followed by an edema of the stump of the prepuce, which, however, need cause no alarm and subsides spontaneously in a few days. The tissues, both the mucosa and skin, are exceedingly thin, and the sutures usually cut out at the end of a week. If, however, the sutures remain at the end of ten days they should be removed.

Fig. 366.—Dressing after Circumcision.

The gauze should be renewed after each urination. At the end of five days following the operation, the edema will have disappeared and the line of union may then be covered with an ointment of aristol and sterile vaselin and the clothing protected by wearing an apron made of a square of gauze fastened about the waist with tapes, the gauze draping down over the genitals.

The glans will be found to be quite sensitive to contact for some days following the removal of the prepuce, especially if it has been left intact until adult life. This may be overcome by frequent lavage of the glans with cleansing fluids to which a small portion of tannic acid is added. At the end of a few weeks the mucosa of the glans takes on more the characteristics of skin and the sensitiveness disappears. The dressings should at all times be so loose as not to compress the penis during erection.

PLASTIC OPERATIONS ON THE PENIS

Plastic operations on the penis for epispadius and hypospadius depend largely as regards favorable outcome upon care in the after-treatment. The urine should be made as aseptic as possible with the view of avoiding infection in the event of infiltration of the wound areas. For this purpose urotropin should be administered for several days before and for a week following the operation. *Bryant* regards leaving a retention catheter in the urethra as less useful with respect to the avoidance of infection, and believes that the presence of the instrument is irritating. He injects into the urethra a small amount of sterile oil after each alternate urination, and has found the procedure very satisfactory. Repeated introduction of instruments into the urethra should be avoided if feasible. A few strands of silk-worm gut introduced into the opening and replaced after each urination is good practice. Care must be exercised in the manipulation to avoid infection. The occurrence of infection in any of the suture holes should be attended with immediate withdrawal of the suture.

The occurrence of erections during the healing is productive of failure of the intent. Pressure upon the vesiculæ seminales from distention of the bladder may be prevented by causing the patient to empty the bladder every four hours night and day. The physiological erection due to a full bladder is thus obviated in most instances. The application of cold, sterile, wet dressings during the day and keeping the bladder empty at night is serviceable, though the execution of these measures is somewhat tedious.

Nevertheless the precautions in this connection need not be carried out for more than five or six days, a minor consideration in comparison to the intent. Bromids may be given during this time. A mixture of sodium bromid, thirty grains, and a quarter of a grain of codein given every three hours seems to be of use. The administration of this combination need not be employed for more than three or four days. An intelligent attendant who wakes up the patient every three hours during the night and causes him to empty the bladder, and who redresses the parts as stated, will contribute much to a favorable ultimate outcome. It seems hardly necessary to state that the attendant had best be of the male sex.

The sutures should be retained in place for ten days. Non-absorbable sutures are preferable in this class of cases, as, indeed, is the case in all plastic work. For the purpose, horsehair, which may be introduced with very slender needles, is the suture material of choice in operating in this class of cases.

URETHROTOMY FOR STRICTURE

Urethrotomy for stricture should be prepared for in much the same manner as is done preliminary to operations on the bladder and prostate. Stricture of the urethra is most commonly a sequel to gonorrheal inflammation of the urethral mucosa with the glandular elements of this membrane, the habitat of the diplococcus of *Neisser*. For this reason it is well to precede the sectioning of the urethra with local treatment for some weeks before the operation if this be feasible. For the purpose the patient visits daily the practitioner, who irrigates the urethra with a solution of protargol, 1 in 200, by the *Janet-Chetwood* method, thoroughly ballooning up the urethra at each sitting, in order to distend the rugæ into which the normal urethra is thrown, and destroying to a certain extent at least the gonococcus. This procedure is employed each alternate day, and upon the day between the urethra is lavaged with a solution of 1 in 5,000 corrosive sublimate. The latter step is employed with the view of destroying any mixed infection of purulent character.

The *Janet-Chetwood* method of cleansing the urethra is employed as follows:

The proper employment of the treatment requires a receptacle of glass or a fountain syringe, hung upon a hook, which latter, suspended over a pulley, may be raised or lowered at will, to vary the pressure of the column of fluid; a conical glass, two-way nozzle (Fig. 367); some small, soft-rubber catheters (8 to 12 French) with carefully beveled eyes and the scissors-like shut-off (Fig. 368).

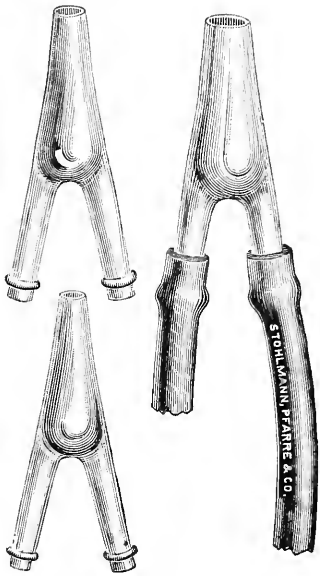


Fig. 367.—*Chetwood's* Two-way Urethral Nozzles. The various sizes are used with respect to caliber of the urethral meatus. (*Keyes.*)

The alternating shut-off instrument clasps the rubber tubes attached to the nozzle, and by a scissors-like motion controls the inflow and the outflow alternately (Fig. 369), impeding the outflow as the fluid enters the urethra, and thus securing an even distention of the canal (Fig. 370), arresting the inflow when the urethra is full, thus allowing the canal to evacuate itself entirely. A proper distention of the urethra is secured by raising the reservoir 4 or 5 feet. Such elevation will not force the membranous urethra, and what pressure there is may be moderated in case of pain by partially closing the inflow tube.

Fig. 368.—*Chetwood's* Scissors Shut Off, Used to Control Flow of Cleansing Fluids used in the Urethra. (*Keyes.*)

The advantages of the alternating shut-off are obvious. Both cleanliness and effective distention of the urethra are better secured by it than by other means. If a one-way nozzle is used, the urethra may be properly distended, but in order to effect irrigation this nozzle must be constantly withdrawn and reinserted—a dirty expedient. If a catheter is in-

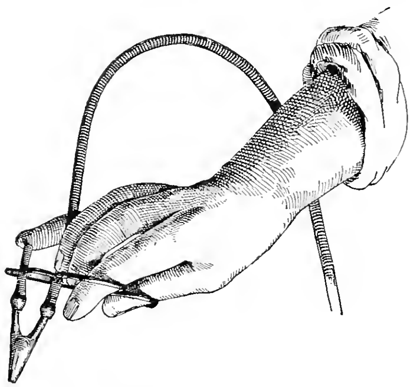


Fig. 369.—*Chetwood's* Irrigator. Filling the tube with fluid before applying it to the urethral meatus. (*Keyes.*)

troduced to the bulb for the anterior irrigation (retro-irrigation), the urethra is not properly distended, and many gonococci in the sinuses and the urethral folds escape.

About one quart of liquid is needed for efficient anterior irrigation, the time required being about five minutes.

If the surgeon prefers, he may irrigate the posterior uretha with this apparatus, simply raising the reservoir; but it is better, after having first thoroughly irrigated the anterior urethra, to use a catheter for posterior work.

For this purpose a soft-rubber catheter, with perfectly beveled eye, is used. The size of the catheter should be from 12 to 15 French. It must be anointed with a lubricant that will dissolve in water. Vaselin or oil will not suffice. A saponaceous lubricant or that made with Irish moss and called lubrichondrin is entirely suitable. The catheter must be introduced slowly and with the utmost gentleness, eye upward, until urine flows, showing that the bladder has been reached. The bladder is now emptied through the catheter and then the latter is withdrawn a full inch, so that its eye may lie just behind the membranous urethra. Now from the irrigator from 4 to 12 ounces of fluid, according to the tolerance of the bladder, are thrown in, washing backward in its course the entire prostatic sinus, after which the catheter is gently withdrawn.

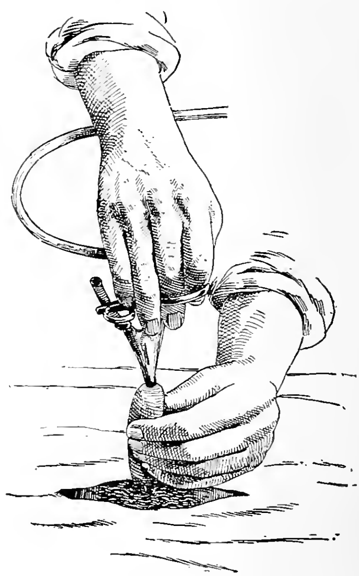


Fig. 370.—*Chetwood's* Irrigator. The fluid entering the urethra. (*Keyes.*)

The patient now urinates out the contents of his bladder, thus giving himself a very efficient final retrojection. (*Keyes.*)

In addition to this the patient should be given large quantities of water for several days before the operation, with the view of mechanically cleansing the urinary passages.

When an external urethrotomy is made, the precautions mentioned are all carried out, and the bladder is drained as is described under Perineal Prostatectomy (page 573). Sectioning of the urethra for stricture is, in a large number of instances, followed by a chill and rise of temperature which is transient and diseappears so rapidly that it is difficult to conceive the systemic disturbance as being due to sepsis. There is, perhaps, a peculiar relationship between trauma to the urethra and the toxemia which follows it. However, the fact that when cases are prepared in the manner stated the chill and rise of temperature does not, as a rule, obtain would suggest that there is some connection in this regard. For this reason a careful preparatory treatment along the lines mentioned is urged.

When the operation is completed, the patient is placed in bed and artificial heat is applied in the manner described under Shock (page 227). As a routine thing a colic lavage of saline solution at a temperature of 110° F. is given at once, and this is repeated in six hours, irrespective of the occurrence of chill. Whether the presence of blood clots in the anterior urethra in cases of internal urethrotomy, or in a bladder after deep urethrotomy, has anything to do with the so-called urethral fever or not, it is, of course, difficult to say. However, this much is true, that febrile movement occurs less frequently as a complication later on (the second day), if the bladder drainage be perfect and the anterior urethra is lavaged with saline solution every twelve hours after the operation. The question of whether sectioning of the urethra liberates into freshly traumatized tissue a certain number of bacteria which have been relatively isolated by protective exudates is also not quite clear. However, cleanliness and drainage, as indicated, seem rational procedures, and may be regarded as preventive measures in this connection. The drain in the bladder is removed on the fourth day after the operation, and the umbrella packing is changed every twenty-four hours until this time. Following removal of the bladder drain the wound is dressed with gauze held in place with a T-bandage (Fig. 344). Urination now takes place for the most part through the perineal opening. The wound is cleansed after each time the bladder is emptied and fresh gauze applied, the patient assuming the sitting posture while voiding. On the sixth day following the operation the anterior urethra is thoroughly cleansed by injecting through it a solution of protargol, 1 in 200, in the manner described above, and a full-sized steel sound is passed into the bladder. As the sound is likely to emerge through the perineal opening, the latter is closed with a gauze pad firmly pressed against the wound, and the instrument carefully pushed beyond it. Should the introduction of the sound be impracticable, it is removed after dilating the urethra to the perineal wound, and reintroduced into the latter and made to enter the bladder. During this time urinary asepsis is to be maintained, as not infrequently a chill and its attendant disturbances obtain subsequent to the passage of the sound. Indeed, this contingency may occur at any time until the healing is complete.

Daily instrumentation is to be avoided. Persistent cleanliness is essential. However, the passage of a sound need not be executed oftener than every four days. This instrumentation is carried on until the wounds are healed, is then done every eight days for six or seven weeks, every two weeks for three months, once a month for six months, and from then on the patient should have a full-sized sound passed every two months for a year or more. A favorable outcome is absolutely dependent upon keeping the canal properly dilated as stated. Recurrence of stricture will thus be avoided.

CHAPTER XXXII

OPERATIONS ON THE EXTREMITIES

Dupuytren's contraction—Hallux valgus—Flat-foot—Club-foot—Osteotomy—Resection and excision of joints—Amputations.

Operations on the extremities involve the problem of locomotion as far as the lower limbs are concerned, and the ability to perform manual labor or the indulgence in voluntary volitional action necessary to life and comfort as concerns the upper extremities. For these reasons the occurrence of postoperative complications following operations upon these parts should be carefully guarded against. Infection with its baneful sequels, deformity and loss of function and impairment of the range of motion of joints, the outcome of ankylosis, are in a measure controllable by strict adherence to asepsis as far as the former is concerned, and by intelligently employed massage, passive and active motion, as far as the latter is concerned. Operations with the view of correcting deformity do not achieve the object unless the subsequent treatment and management of the case be properly carried out.

DUPUYTREN'S CONTRACTION

Dupuytren's contraction after the fascial contractures have been divided will recur, unless complete repair has taken place with the parts in the corrected position. The wound is dressed in the usual manner, and the fingers held in position by either a palmar or dorsal splint. As the pressure due to the stretching of the skin of the palm, of itself, is liable to cause sloughing, it is best to apply the splint to the dorsal aspect of the hand and bandage the parts to it. Fig. 371 shows a splint which is quite useful for the purpose. A pad of gauze is placed over the palm and the fingers bandaged to separate portions of the splint. The wrist is also encircled with gauze and the splint applied over this. The splint may consist of shellac, or soft wood, or sole-leather, or malleable tin, the latter having the advantage of permitting of modification of the degree of extension used.

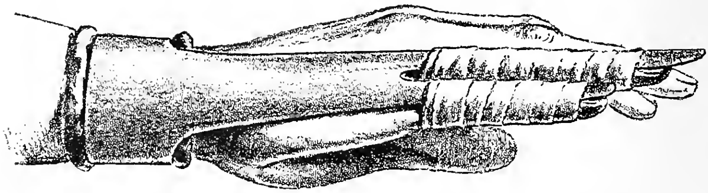


FIG. 371.—*Dupuytren's* CONTRACTION. SPLINT FOR MAINTAINING COMPLETE EXTENSION AFTER OPERATION. The splint is made of malleable tin and can be bent slightly upward in order to over-correct the deformity. (*Cheyne.*)

At first the fingers are placed in the position of over-extension, though this is not at all times well borne by the patient. In the event of the over-corrected position being painful, or if the skin of the palm shows any signs of undue pressure, the splint may be bent to accord with less forcible extension. For this reason the splint is best made of material which will permit of these manipulations. The wound is treated as are wounds in other situations. The correcting splint is worn night and day for three or four weeks. Later a splint which has prolongations which confine only the affected fingers is worn, thus allowing of a certain use of the member. At the end of six weeks the splint is worn only at night, though its noturnal application should be maintained for six months. When the splint is removed during the day, the hand is subjected to massage and kneading, the part being covered with lanolin or other lubricant during the manipulations, with the view of softening the skin and stretching the fascia and ligaments of the joints. The superheated air apparatus, such as is used for the treatment of rheumatic joints, may be used and seems to be of service.

The deformity is liable to return after a long period of time, and the patient must be instructed to employ correcting manipulations regularly for several years after the operation. This need not be made a hardship. A few minutes of massage, kneading, and the use of pulley weights, which extend mechanically the fingers, every morning will be found to meet the indications.

HALLUX VALGUS

Hallux valgus when subjected to operative relief is followed by immobilization of the parts, by the application of a splint to the internal surface of the foot. The wound is covered with the protective dressing, a gauze pad is placed between the large and second toes, to make outward pressure, and a splint is applied, as

Fig. 372.—Lateral Splint for Holding Toe after Operation for Hallux Valgus. (*Foote.*)

shown in Fig. 372. The toe is held in contact with the splint by adhesive plaster.

If no special indication arises, the wound is not dressed until the tenth day after the operation, at which time the stitches are removed. If there has been much oozing, the wound is drained, in which event the dressing is removed on the third day and the drain removed. The parts are now again immobilized, as stated above, and the wound is left undisturbed for the remaining seven days. At this time the toe is moved slightly and a silicate of soda splint applied which holds the parts in place. At the end of another three days the patient is permitted to go about with the toe held in the position mentioned, the shoe being cut away for the purpose. The corrected position is maintained for six weeks, at the end of which time passive motion may be begun. After recovery the patient is instructed to wear a shoe which will obviate recurrence of the deformity. Fig. 373 shows an outline

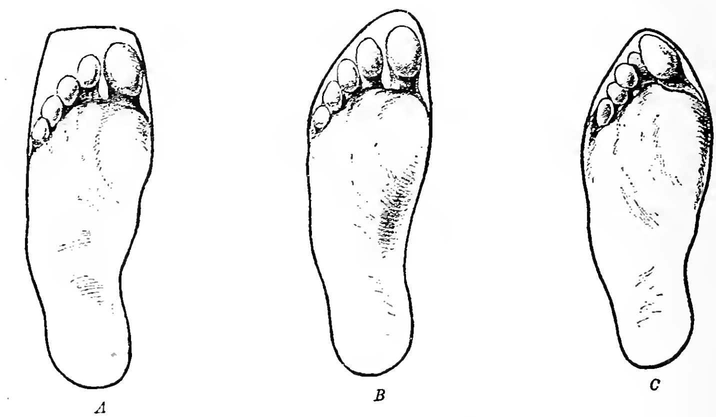


Fig. 373.—Hallux Valgus. Diagram Showing the Principle Involved in Making Shoes. *C* shows the deflection of the great toe and the cramped position of the others entailed by this kind of shoe. It will be seen that the point of the shoe lies along the middle line of the foot. *B* shows the outline of the sole of a shoe constructed on sound anatomical principles. The inner border of the flat part of the sole is nearly parallel to the long axis of the foot, the boot comes to a point opposite the great toe, and is sloped away from that point to the outer border in accordance with the length of the other toes, which are thus not cramped at all. *A*, a very usual form of so-called anatomical shoe, which, while it is free from the most flagrant faults of the shoe shown at *C*, is not so good as *B*. The inner border of the sole is not quite straight, and so tends to deflect the great toe somewhat, while the squareness of the end of the boot both leaves a lot of unnecessary space between it and the toes and detracts considerably from the appearance of the foot. (*Meyer.*) (*Cheyne.*)

to which the shoe should correspond. The important factor in the construction of a suitable shoe is to have the internal line of the footwear make a straight line from the metatarsophalangeal articulation to beyond a line drawn transversely across the distal termination of the great toe. Patients find it convenient to wear a pledget of cotton between the great and second toes (Fig. 374) for a long time after recovery is complete. In some instances a specially constructed shoe with a separate compartment for the great toe (Fig. 375) will be found of use. It is to be borne in mind, however, that the "toe-post" may make pressure upon the inner surface of the toe, giving rise to pain and annoyance, and its employment may have to be abandoned for this reason. When the "toe-post" is used, it may be difficult to insert the phalanx into the compartment. For the purpose a gauze plug is inserted between the toes (Fig. 374), to which a string is attached. When the toe is felt to engage in the compartment, the plug is withdrawn by means of the string. Of course, the use of the device necessitates the use of a digital sock.

Fig. 374.—Pledget of Gauze Arranged to Overcome Tendency to Recurrence of Hallux Valgus, after Operation.

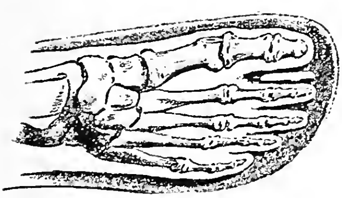


Fig. 375.—Diagram to Illustrate "Toe-post." The "toe-post" is seen in the cleft between the great toe and the second. It is made of stout leather or wood and is fixed to the sole of the boot, which should be of the shape shown in the figure. The great toe is thus confined in a compartment from which it cannot escape, and no lateral deflection is permitted. (*Cheyne.*)

FLAT-FOOT

Flat-foot is exceedingly liable to recur after operative correction. In most instances operative measures of relief are followed by placing the foot in the over-corrected position and immobilizing it in plaster-of-Paris for six weeks (Fig. 376). A window is cut in the cast on the third day after the operation corresponding in extent to the wound. The dressing is changed as frequently as is necessary without disturbing the position of the foot. At the end of the six weeks of immobilization the cast is removed and provision is made for obviating recurrence of the deformity. A suitable steel spring is

Fig. 376.—Markedly Rigid Flat Feet put up in a Corrected Position in Circular Gypsum Splints. (*Foote.*)

worn in the shoe (Fig. 377). The "artificial arch" is made of steel or aluminium, the latter being preferable as less influenced by moisture than the former. Fig. 377A shows a lateral view of the appliance, Fig. 377B shows the spring from the plantar surface. When the support is fitted to the foot, it should be molded so as to extend forward almost to the ball of the foot, outward

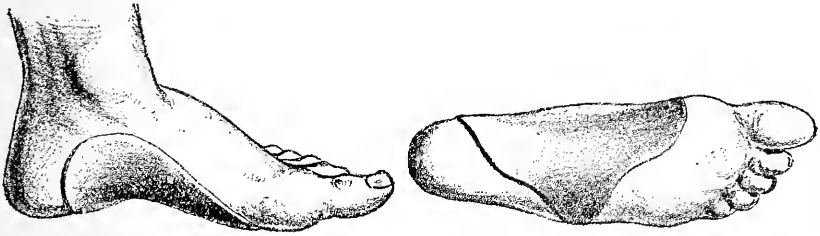


FIG. 377.—*Whitman's* SPRING FOR FLAT FEET. *A*, The splint is seen from the inner side applied to the foot, it shows the prolongation upward. In *B*, the splint is shown from below, and shows the extent of the spring in front, behind and externally. (*Cheyne.*)

to the outer edge of the foot, and backward to just in front of the tuberosity of the os calcis. The foot plate appears as shown in Fig. 378, as modeled by *Hoffa*. The outer edge of the appliance is slightly raised to keep the foot from slipping laterally. The appliances instrument makers carry in stock should not be employed, but each foot must be held in the corrected position while a mold is made and the appliance made to fit this.

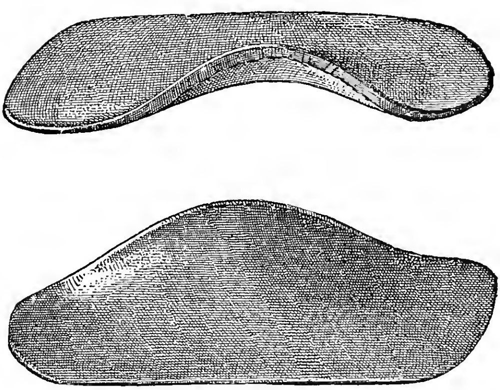


FIG. 378.—LATERAL AND INFERIOR VIEW OF *Hoffa's* FOOT PLATE FOR FLAT-FOOT. (*von Bergmann.*)

In addition to this, a specially constructed shoe should be worn. Fig. 379 shows a boot which is of great service in achieving the purpose. The heel of the foot is carried forward on the inner side of the shoe until it meets the front part of the sole. The sole and heel are made thicker on the inner side, so as to raise the inner border of the foot. This causes the patient to walk with the toes turned inward and aids in the intent.

It is probable that comparative weakness of the muscles of the leg have a bearing on the deformity. The patient is instructed to raise himself on his toes ten to twenty times twice daily, and this exercise is increased until he is able to raise himself in the manner stated a large number of times at a sitting.

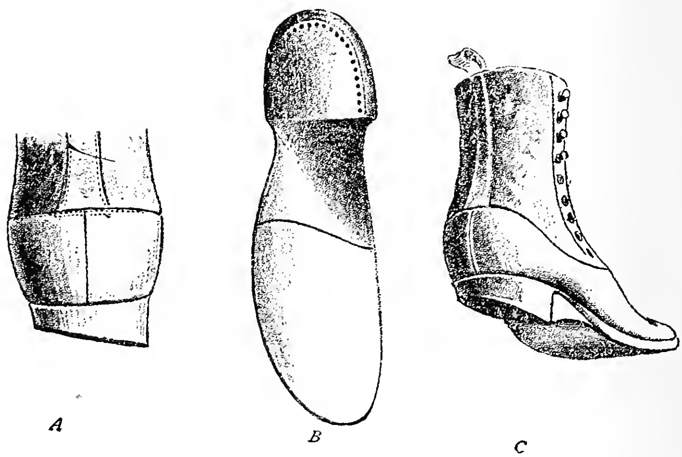


Fig. 379.—Boots for Flat-foot. In *A* is shown the obliquity of the heel as seen from the back. In *B* the boot is seen from below and both the obliquity of the heel and the filling up of the arch of instep by carrying the heel forward to meet the sole are shown. The prolongation of the heel forward is oblique in the same direction as the heel, it is represented by the unshaded area in front of the heel in *C*, which is a view of the inner side of the boot. (Modified from *Hoffa*.) (*Cheyne*.)

He should also attempt to walk on the outer aspect of the foot while barefooted. As the result of continued immobilization, while the operative wound is healing, the muscles of the leg undergo a certain degree of disuse atrophy, and the operative measures of relief employed will fail in their purpose unless the suggestions offered or some modification of them be assiduously carried out after the operation. The support and the conformation of the shoe are of course mechanical measures. The shoe, perhaps, tends to cause a genuine correction. However, the deformity must be overcome as the outcome of proper exercises, a fact which must be borne in mind. Immediately after the operation, massage and manual correction movements may be employed, and, especially in young children, will be found of considerable service. Fig. 380 shows the position which the manipulations should aim at.

Fig. 380.—Manipulation to Overcome Recurrence of Flat-foot after Correction. (*Foote.*)

CLUB-FOOT

Club-foot may be regarded in the same light as to after-treatment as applies to flat-foot. Indeed, the ultimate outcome is greatly dependent upon persistent exercise and manual correction. Immediately after division of the restraining contractures the foot may be put up in the manner shown in Fig. 381. The dressing consists of a piece of wood of suitable size and thickness, such as the lid of a cigar box, long enough to extend from the heel to at least three inches beyond the tip of the toes, which is cut to the shape of the foot. A piece of strapping between two and three inches broad, and sufficiently long to reach from the middle of the thigh to the toes and then twice the length of the splint, is first applied to the upper surface of the splint, beginning near its anterior extremity, carried along the upper surface, round the posterior edge, and then along the lower and over the anterior edge again. This part of the strapping is then firmly incorporated with the splint by means of two or three transverse pieces of strapping (Fig. 381). Upon the splint thus

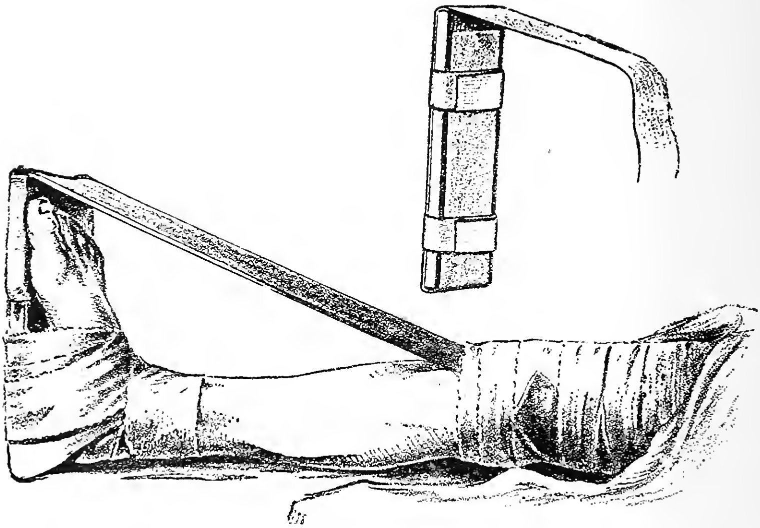


FIG. 381.—*Sayre's* APPARATUS FOR USE AFTER TENOTOMY OF TENDO-ACHILLIS. The smaller cut shows the method of attaching the strapping to the foot splint. (*Cheyne.*)

prepared are laid two or three thicknesses of boric lint, so as to form a padding, and the splint is then fastened at the heel, sandal-wise, by a broad strip of strapping passing around the instep and the posterior part of the splint to the front of the foot; the splint is then secured to the foot by an ordinary bandage. The long piece of strapping which now hangs over from the front of the splint is next carried up along the anterior surface of the thigh, the foot meanwhile being held at right angles, and the knee in the fully extended position. The strapping is applied to the limb and fastened in position by a bandage, which commences just beneath the patella and is carried up to about the center of the thigh. The free upper end of the strapping is then turned down, and the bandage carried downward over it; in this way the strapping is thoroughly incorporated with the bandage, and both are firmly fastened to the skin of the thigh. Should the strapping slip, as it frequently does after two or three days, it is not necessary to apply fresh strapping in order to tighten it, but a second bandage may be applied over the old one, and carried down farther below the patella; this will keep the strapping taut. The patient should be encouraged to walk wearing this apparatus. The effect of this is that, as the splint is longer than the foot, considerable leverage is exerted upon the ankle joint, and the latter is well bent as the patient walks. The flexion is far more effectually carried out than if the foot were simply incased in a shoe. By the use of this apparatus, also, the calf muscles are left free, and massage can be applied to them. The apparatus will generally require renewal about once a week. (*Cheyne.*)

Plaster-of-Paris will also be found the serviceable material for the purpose, being easily applied and holding firmly the parts in position. Immobilization should be maintained for three weeks, at which time the dressing is removed and the patient subjected to massage, and is encouraged to freely move the foot.

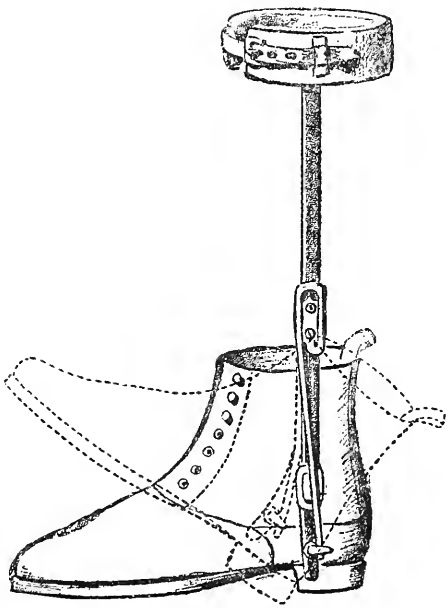


FIG. 382.—BOOT FOR USE AFTER TENOTOMY OF TENDO-ACHILLIS. The dotted line shows the position the boot tends to assume when the foot is off the ground. It thus continuously stretches the Tendo-Achillis. The boot should be made a good deal longer than the foot, and it should have a stop at the ankle-joint hinge to prevent the toes being pointed. (*Hoffa—Cheyne.*)

A tendency to recurrence of the deformity will be noted soon after the plaster is removed. To overcome this the patient is made to wear a boot of especial construction (Fig. 382). It will be seen that the boot is furnished with a brace fastened about the leg by means of a padded strap; a spring forces the foot in the position shown by the dotted outline. The shoe must be considerably longer than the foot. The apparatus stretches continuously the tendon and fascia, and the heel comes in contact with the ground as the patient walks. It must not be considered that the apparatus will permanently cure the condition; on the contrary, the spring takes the place of the flexors of the foot, and as the ultimate outcome is dependent upon the resumption of contractility of the anterior group of muscles which have long been comparatively useless, it is patent that systematic massage and exercise of these muscles must be carried out. Indeed, the patient must be taught to exercise the flexor muscles without the aid of any artificial apparatus, and the brace should be discontinued as soon as possible.

Of course the muscles of the calf are more largely used in the daily functions, and for this reason special forms of exercise other than locomotion must be employed. For the purpose a rowing machine with a sliding seat or similar device which compels the patient to pull the body forward by the anterior tibial muscles will be found exceedingly useful.

OSTEOTOMY

Osteotomy for bow-legs or knock-knees is followed by immobilization of the parts in the corrected position for six weeks. Immobilization is achieved by various forms of splints. However, it will be found that plaster-of-Paris is the most useful agent for the purpose. The wound of approach to the site of bone section is rarely infected, and though horsehair or silk-worm gut drainage may be employed, the drainage agent may be withdrawn from the wound on the third day following the operation, through a window cut into the plaster corresponding to the wound. The wound is then redressed and the sutures removed on the tenth day. In most instances it will not be necessary to disturb again the dressings until the immobilizing apparatus is removed.

Should, however, infection of the wound occur, it may be treated through the window in the plaster cast, already mentioned, without the disturbance of the fractured bones which obtains when splints are used, the latter, of course, having to be removed for the purpose.

As osteotomy for deformity is usually done in cases where there is a certain pathological condition of the bones, the patient should be confined to the bed for several weeks after union has taken place, and the diet be arranged with the view of obviating the constitutional fallacy. The phosphates of lime and soda, together with general tonics, should also be administered. In young adults it is well to supplement the treatment stated with the application of an apparatus which will tend to obviate recurrence of the deformity. For the purpose, in cases where knock-knee has been corrected, an apparatus, such as shown in Fig. 383, may be used. The joint in the iron brace permits of flexion of the knee, and a similar one at the ankle joint permits of motion in the latter. These provisions are essential to conserving muscular tone. The traction is made at the various points shown in the illustration. The apparatus should be worn for several months following the operation.

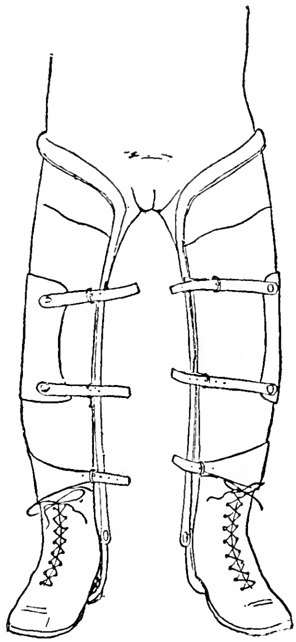


Fig. 383.—Apparatus for Bow-legs. (*Dennis.*)

After correction of bow-legs a silicate of soda splint may be worn for several weeks following the operative relief. The splint, however, should not include either the knee or ankle joints.

As exercise of the muscles of the limb while held in a normal position is essential to ultimate success, the apparatus should be worn during locomotion, and supplemented with exercises while the patient is in the sitting posture. The practitioner must bear in mind that the deformity of bones is simply a symptom, and the constitutional treatment must be destined to correct the fallacy. Again, the simple correction of the deformity must be supplemented by protracted employment of massage and exercise in order to achieve a favorable ultimate result.

RESECTION AND EXCISION OF JOINTS

Resection and excision of joints, if done for the purpose of correcting deformity, or to achieve motility of joints following afflictions which have healed, are succeeded by complete closure of the wound and immobilization of the parts until the wound is healed. Drainage is not employed in these cases unless for special indications, such as persistent oozing of blood, or because of extensive trauma to the parts. For the purpose the limb is held quiescent by means of splints, which latter are applied over the usual protective dressing. For the purpose of immobilization, plaster-of-Paris or silicate of soda will be found most serviceable. If drainage has been employed, a window corresponding to the wound area is cut into the incasing immobilization apparatus, and the drain is removed on the third day following the operation. Seven days later the wound is again exposed and the sutures removed from the wound. Of course, when absorbable suture material has been employed, the latter step need not be taken. If no drainage has been introduced into the wound, and there be no evidence of infection, the wound need not be disturbed until the tenth day, when the sutures are removed. At the time that the drainage is removed, the dressing is made under strict aseptic precautions. When the sutures are removed and there be no evidence of infection expressed by pain, rise of temperature, etc., the precautions with respect to asepsis are likely to be disregarded. The practitioner is warned against laxity in this connection, as late infection may occur as the outcome of neglect in this regard.

A moderate degree of infection is very likely to occur following resection of joints, due, perhaps, to the fact that parts which have been restricted with respect to motility do not seem to have the same degree of resistance to the invasion of infective processes as obtains when the normal physiological functions have been impaired only for a short period of time.

Immobilization of a limb following resection of a joint should not be maintained longer than is necessary to accomplish repair of the wound. The process of healing is in many regards quite similar to that of the affliction which caused the pathological condition for the relief of which operative measures are undertaken. If no infection exist at the time of the operation, passive motion should be employed as soon as repair of the wound is sufficiently advanced to justify its use. Indeed, it is probable that joints which have been subjected to operative attack should not be held quiescent for more than three weeks and passive motion should be employed at this time, even though complete repair of the wound is not yet attained. In instances in which no infection exists at the time of the operation and relief of impaired usefulness, the outcome of repair following injury, is aimed at, passive motion may be begun from the day upon which the sutures are removed.

When passive motion is begun, the original cast is cut down and a second lighter one applied. This is cut down immediately, that is, before the plaster is quite hard and a light gauze bandage made to hold the sectioned cast in place. The splint is removed daily, the wound dressed, and the limb subjected to passive motion. In the meantime, the patient is encouraged to move actively the parts of the limb contiguous to the joint immobilized, with the view of facilitating nourishment and return of function. As soon as repair is complete, the patient begins to use the limb, removing the cast for the purpose for several hours each day and reapplying it at night. In this way a certain degree of recurrence of the deformity, which is very liable to occur, is obviated. During this time the patient is to be kept under observation and, if necessary, the apparatus worn at night should be so constructed as to overcome any tendency toward deformity or ultimate limitation of motion.

Ankylosis after resection of joints is aimed at in the knee-joint. In these cases the femur and tibia are held in apposition, with the view of attaining union between the two bones, either by means of apparatus or by the introduction of various agents, such as wire or pegs or nails. In this class of cases the immobilization is maintained until union is complete, which requires from six to eight weeks. However, the wound is treated in much the same way as are the wounds in other portions of the body. When infection exists at the time of the operation, such as obtains with joint tuberculosis, drainage is invariably employed, and the wound will have to be treated for a considerable period of time.

As regards the knee joint, the character of dressing which makes accessible the wound while union of the bones takes place, is similar to that following resection, when infection exists, and will be described under one head. Fig. 384 shows an apparatus which is of service in both classes of cases. The leg is incased in plaster-of-Paris, which is carried upward posteriorly supporting the popliteal space. The thigh is also incased in the same material, as shown in the illustration. After a few layers of plaster-of-Paris bandages have been applied, a stout steel wire,

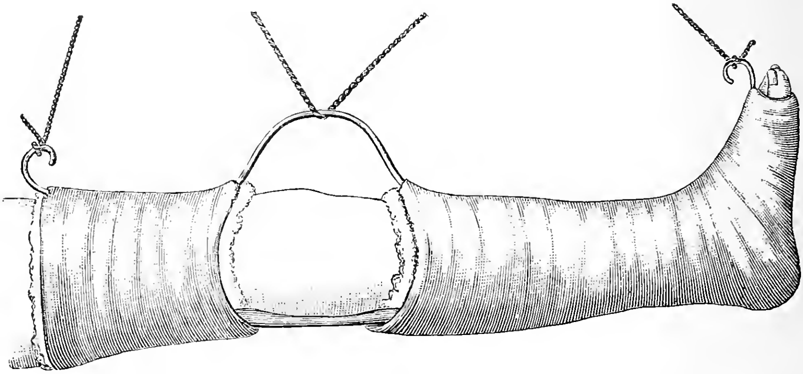


FIG. 384.—SUSPENDED BRACKETED PLASTER-OF-PARIS SPLINT. (*Bryant.*)

bent in the fashion shown in the illustration, is applied to the anterior aspect of the limb, and is buried by successive layers of plaster-of-Paris bandages, leaving uncovered the portions shown

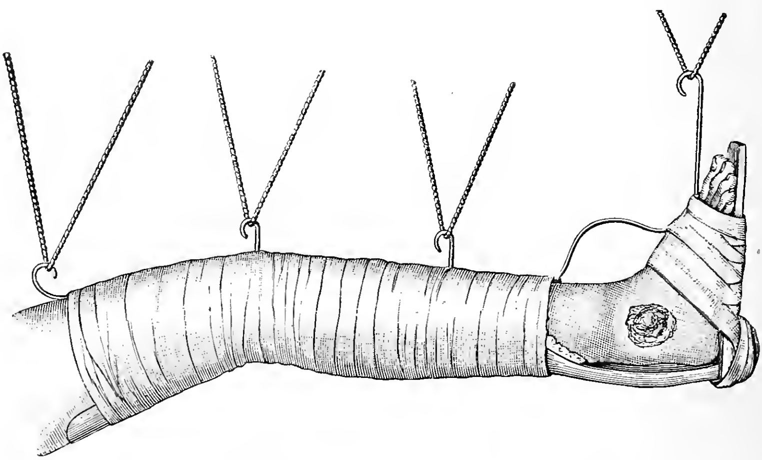


FIG. 385.—BRACKETED SUSPENDED PLASTER-OF-PARIS SPLINT FOR EXCISION OF ANKLE JOINT. (*Bryant.*)

exposed in the picture. The limb may be swung by means of cords from a pulley fastened above the bed. The region of the joint and the wound are thus made readily accessible, and the dressing may be frequently changed and the wound treated without disturbance of the relationship of the bones.

A similar device applied to the ankle joint is shown in Fig. 385. Fig. 386 shows the same principle applied to the wrist. In

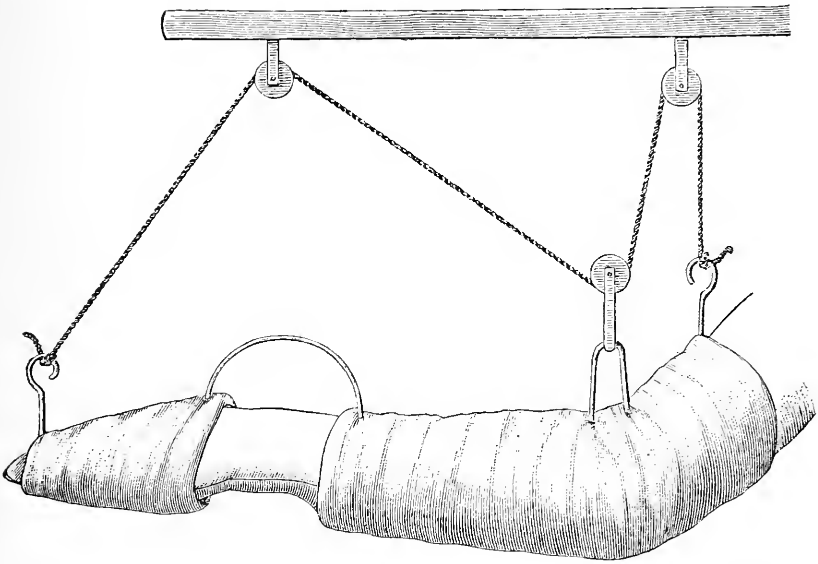


Fig. 386.—Bracketed Suspended Plaster-of-Paris Splint for Excision of Wrist Joint. (*Bryant.*)

cases of this sort, the joints contiguous to the afflicted one are also immobilized as muscles which animate them cross the afflicted joint. Complete immobilization of the limb should not, however, be maintained for more than three weeks, at which time the apparatus is removed and the immobilization confined to the afflicted joint. In joints where ankylosis is not aimed at, where, however, infection exists at the time of the operation, passive motion is begun at the end of three weeks, even though repair is not quite complete. The limb is incased in a removable immobilization apparatus which is removed daily, and active and passive motion is employed as stated above. If the repair is slow, as is likely, especially if relief of joint tuberculosis is undertaken, the *Bier* treatment may be applied for several hours each night, the constriction being applied with the immobilization apparatus in place. There is a tendency to unnecessarily prolong the immobilization of the joint. While protracted quiescence of tuberculous joints which are being conservatively treated may be justifiable, it is not indicated in cases in which the tuberculous disease has been removed by operation, and motility of the joint is aimed at. During the after-treatment of cases of this sort, the constitutional treatment directed towards correcting the cause of the joint affliction should be assiduously carried out.

In the treatment of the wound itself, it must be borne in mind that when complicating purulent infection does not exist at the time of the operation, it is exceedingly liable to occur subsequent to the operation, and must be avoided by adherence to the rules of asepsis. In a measure the lessened resistance of the patient makes mixed infection more likely to occur under these circumstances. A sinus leading to a small portion of bone which is exfoliating, the outcome of trauma at the time of the operation, should not be turned over to the patient for treatment, unless he happen to be intelligent enough to observe the necessary cleanliness.

AMPUTATIONS

Amputation wounds are, as far as the after-treatment is considered, divided into two kinds. Those which are left open, and those in which the flaps are approximated and drainage established.

The open method of treating wounds following amputations is employed in cases where infection exists at the time of the operation, especially if the infection be irregular in its extent, and the remaining stump be the residence of infective process which does not invalidate the vitality of the tissues remaining. For instance, an osteomyelitis involving the lower ends of the femur and extending into the shaft may call for amputation, but the bone section may be made just above the condyles, the shaft of the bones scraped out and cleansed, the wound packed and ultimately complete repair takes place, while at the same time a considerable extent of the limb is saved. In these cases approximation of the flaps by suture would serve no useful purpose, and, indeed, healing by granulation gives in the end a stump which is in all respects as serviceable as obtains when primary union is achieved, the only disadvantage being, perhaps, that the former method of healing is a more prolonged one. However, the certainty of removal of offending secretions, and the accessibility of the parts to postoperative treatment and care argues strongly for employment of the measure in a certain class of cases.

When the stump is treated by the open method, the wound is packed moderately firm with sterile gauze for forty-eight hours (Fig. 387). Iodoform gauze or other so-called medicated gauze

FIG. 387.—OPEN METHOD OF TREATING AMPUTATION WOUND.

should be used with discretion, as the large raw surface it comes in contact with will absorb the medicament and poisoning is liable to occur. The packing is left in place no longer than the two days mentioned, when it is removed. When infection of the deep parts is present, firm packing interferes with drainage and the gauze should be only lightly placed into the wound, with sufficient spaces between the layers to permit of egress of the secretions. In the latter class of cases the gauze may be soaked with a solution of carbolic acid, 1 in 500, and the entire limb covered with gauze saturated with the same solution. This dressing should not, however, be left undisturbed for more than twenty-four hours, at which time the wound is cleansed with normal salt solution, with the view of removing thoroughly the carbolic acid solution. The stump should not be treated with a solution of carbolic acid for more than a day, and the second dressing should be wet with saline solution, in order to obviate the maceration and at times sloughing which attends the prolonged use of the carbolic acid. When the gauze saturated with saline solution is removed, peroxid of hydrogen may be injected into the wound, with the view of loosening the gauze from the raw surfaces, though this measure is not as essential as in cases in which dry gauze is introduced into the wound. The stump is irrigated with a solution of corrosive sublimate, 1 in 2,000, all secretions are removed and sloughing tissue picked off with dressing forceps. The protective dressing should be applied with just sufficient pressure to hold it in place. Firm bandaging is, perhaps, justifiable for the first twenty-four hours following the operation with the view of controlling oozing of blood, but should not be maintained longer than this as in cases where infection is present. The flaps have already lost some vitality as the outcome of the pathological process, and should not be subjected to additional burden in this regard.

When the wound is clean, that is, if no infection exists at the time of operation, such as is the case when the amputation is made for trauma or for the removal of deformed or useless limbs, the flaps are approximated by suture and drainage is employed.

For the purpose silk-worm gut may be used, though at times catgut is used. The reasons for preferring the former in approximating the skin has already been mentioned (page 97). Drainage with a rubber tube which emerges at either angle of the wound will be found to be the most useful in this class of cases (Fig. 388). This arrangement enables the attendant to irrigate through and through from either side, and clots and secretions are readily removed. Textile fabric may be used for the purpose, but does not permit of cleansing of the wound with the facility which obtains when tube drainage is employed. The final dressing of the stump in either class of cases should be supplemented by the application of a splint immobilizing the limb (Fig. 389). The limb should also be placed in a position which obviates tension on the flaps, the thigh or arm being supported by a pillow, and the bedclothes kept from coming in contact with the parts by holding them away by means of an appropriately arranged canopy. The tube drainage is removed on the third day following the operation, provided infection has not occurred. If infection occurs, the tube is changed and another one introduced, which procedure is

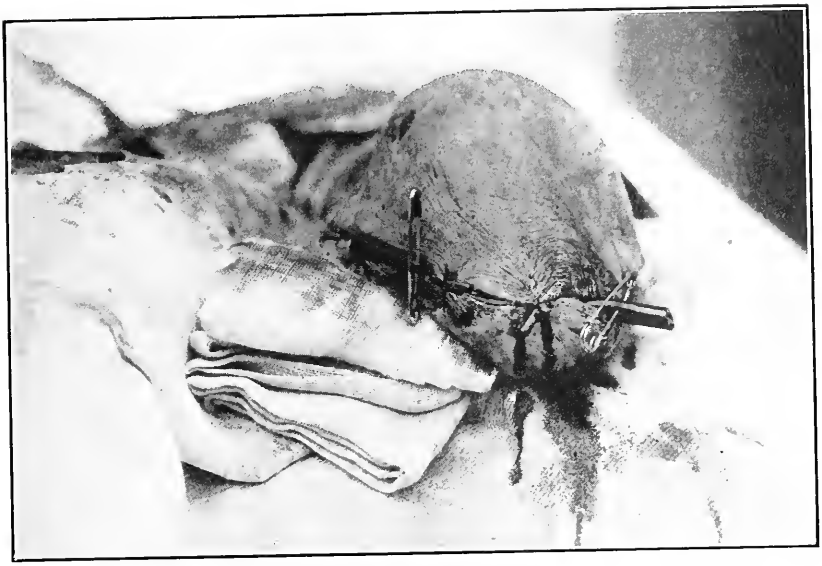


Fig. 388.—Amputation Wound Closed with Interrupted Sutures and Tube Drainage Introduced.

repeated at intervals of forty-eight hours until the infection subsides, at which time horsehair or silk-worm gut drainage (page

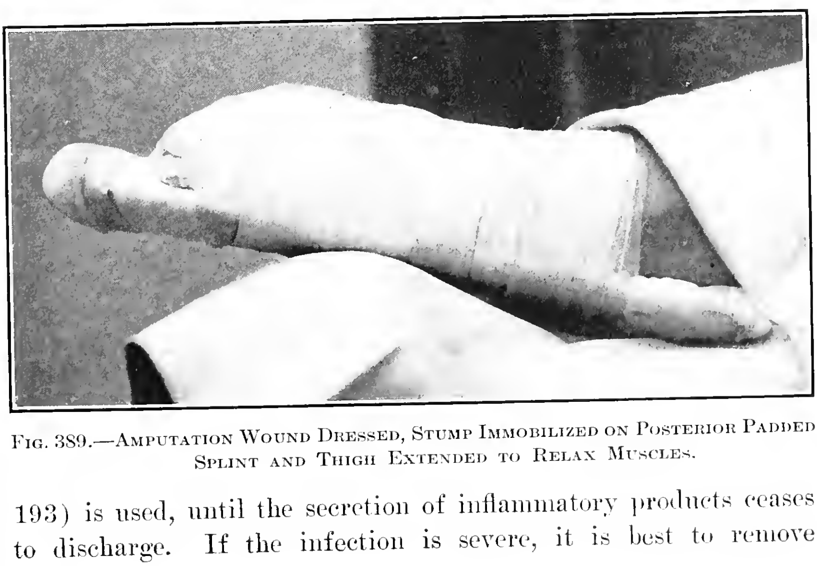


Fig. 389.—Amputation Wound Dressed, Stump Immobilized on Posterior Padded Splint and Thigh Extended to Relax Muscles.

193) is used, until the secretion of inflammatory products ceases to discharge. If the infection is severe, it is best to remove

entirely the sutures and treat the case as is described under the "open method" of handling the problem.

A certain amount of secretion is discharged in all instances following amputations. This is a part of the process of repair, although the character of the discharge varies with respect to whether pus is formed or not. A part of the secretion is due to a certain amount of superficial necrosis of the divided ends of bones, and, indeed, even in cases in which primary union is practically obtained, a small sinus corresponding to the point of egress of the drainage tube may persist for several weeks after the operation, which finally heals when the portion of bone has been exfoliated. In cases where infection exists at the time of the operation, a considerable degree of necrosis of bone usually follows, and this may cause the wound to remain open at some point for a considerable period of time.

In clean cases it at times happens that the necrosed bone does not manifest itself until after the superficial wound has healed, and the case then presents the signs and symptoms of inflammation. An incision made into the inflamed area liberating the exudate and subsequent light packing will meet the indications. Sutures are removed on the tenth day following the operation. When tension sutures are employed (page 215), these are removed at the same time.

If infection of the superficial wound occurs the deep or tension or relaxation sutures need not be removed until the time stated, even though it may have been necessary to remove the greater part of the approximation sutures. Of course, if the entire surface of the wound be infected and pus form beyond the relaxation sutures, these, too, must be immediately removed. Uninfected cases heal in about two weeks including the drainage tube openings, which latter require a little more time for complete healing than obtains with respect to the rest of the wound.

When healing is complete, either in the cases in which the open method or closure of the wound has been practiced, the limb is incased in a light dressing, and the contiguous joint is subjected to progressive, passive, and active motion.

Systematic massage of the healed stump should be begun as soon as feasible. The patient is instructed to subject the stump to frequent handling and manipulations with the view of creating a tolerance for the pressure of an artificial appliance. For the purpose lanolin or vaselin may be used and the skin is bathed with soap and water and sponged with alcohol, after which a dusting powder of bismuth or similar agent is applied.

There is no fast and hard rule applicable to what time an artificial limb may be applied. On general principles it may be said that as soon as the manipulations mentioned are well borne, the artificial appliance may be used for a certain period of time each day and discarded when evidence of irritation appears. As soon as pain and redness appears the apparatus must be laid aside and the skin treated in the manner stated until the irritation disappears, when the artificial limb is again applied. Tolerance for the peculiar condition of affairs will soon be established. Under no circumstances should an attempt be made to force the situation by persistence in wearing the apparatus in the presence of irritation of the stump.

As soon as the patient convalesces he should be encouraged to go about. When the lower extremity has been in part or entirely removed, the patient will be compelled to use crutches for some time, while the stump is prepared for an artificial appliance. Locomotion with crutches should contemplate coördination with the lessened parts concerned in it. This is not always rationally attempted. Even though an artificial appliance is to be used, the training with crutches is essential in order to cause a certain compensatory hypertrophy of the remaining limb and to establish a new sense of balance. For the purpose the crutch should be so constructed as to permit of locomotion without undue pressure upon the axilla. Most of the weight should be borne by the hands which grasp the crutch at such a distance from the axilla as to obtain the desired condition of affairs. Failure to instruct the patient in this regard causes pressure upon the brachial nerves, chiefly the musculo-spiral, giving rise to a condition known as "crutch paralysis." This is an exceedingly distressing occurrence and should be avoided.

The additional advantage of early locomotion is the greater rapidity with which patients regain a normal general condition, to which may be added the improvement in the mental condition as the outcome of resumption of some occupation.

CHAPTER XXXIII

ARTIFICIAL LIMBS

Instep amputations—Retracted heels—Ankle-joint amputations—Leg amputations—Knee-bearing stumps—Thigh stumps—Hip-joint amputations—Amputations of upper extremities.

With respect to artificial appliances to the stumps following amputations of the lower limbs it is necessary, in order to have an intelligent conception of the rationale of the apparatus, to be acquainted with the mechanism of locomotion.

Kinetoscopic photography has been an exceedingly valuable aid in the study of the actions of the knee and ankle joints during locomotion. The conclusions arrived at would seem to justify the belief that a person walking at the rate of two miles an hour flexes the knee but slightly and the ankle considerably. When walking at the rate of three miles an hour, the knee joint acts through a greater range and the ankle joint through a lesser one. When walking with moderate speed, say at the rate of four miles an hour, the knee action becomes considerable and the ankle action scarcely perceptible. When walking rapidly, say five miles an hour, the knee action is increased and the ankle becomes practically rigid. When running, the knee increases its action and the ankle reverses its action and throws the pedestrian forward by the ball of the foot.

The ratio between the range of motion of the knee and ankle joints is in proportion to rapidity of the act of locomotion. An impulse to walk slowly or rapidly, or to change from one gait to another, is formulated in the pedestrian's mind, this is conveyed to the muscles of the limbs, which act is in accord with the impulse. A person whose muscles do not respond in accord with the mind becomes incoördinate in his gait. If an artificial leg be supplied with an ankle joint which is not under control of the will, the wearer is in much the same position as a person afflicted with ataxia.

Three miles an hour is the rate at which the average person walks. Successive photographs of a man walking at this gait show that there is but little motion in the ankle joint and, limited as it is, it is of a character which can not be imitated by mechanical means.

Artificial feet with ankle joints set to act at a constant range of motion allows the wearer to walk fairly well at a slow rate of speed, but at a speed of three or more miles an hour, the step becomes perceptibly awkward, and the effort required to overcome the too liberal motion in the ankle is fatiguing. So far as the knee joint is concerned, the motions of the artificial and natural legs are approximately the same, but the motions of the ankles are very different. The sole of the foot is flat on the ground for a considerably longer period of time with the artificial ankle joint, than obtains with the natural one. As the walker advances and strikes the heel of the artificial foot on the ground, almost immediately the front of the foot drops and the entire sole rests on the ground and remains there during the interval through which the body passes over it.

A person walking with natural feet throws the left foot forward, barely touching the heel to the ground. Instantly the right foot under control of the tendo-Achilles extends and the heel is raised from the ground, throwing the weight of the body on the ball, supplying the impetus that urges the body forward. As the body is carried forward, the ball of the foot reaches the ground at about the time the body is vertically over it. At this point the right foot is in the act of leaving the ground, and is passing the left which, still being flat on the ground, performs no function, except that of supporting the body. The right leg is carried a little farther forward when a slight amount of flexion occurs in the left ankle joint. But this is quite transient. The tendo-Achilles instantly contracts and the foot extends, the entire body is lifted and thrown on the ball of the foot, and when the weight of the body is placed on the heel of the right foot, there is a slight flexion in the knee-joint which permits the sole to reach the ground. At this time the knee-joint of the left foot is flexed and the foot of that leg is raised, and when the weight of the body is practically over the right foot, the knee is extended, so as to support the weight securely.

Artificial feet without ankle joints when supplied with rubber cushions and the so-called "spring-mattress" are capable of imitating more closely the natural mechanism of locomotion than obtains with those supplied with artificial ankle joints. As the walker advances on the rubber foot, he touches the heel to the ground, the weight is applied, and the sponge rubber in the heel compresses sufficiently to allow him to roll on the bottom of the foot. The moment the body is carried a little in advance, he rises on the ball very much the same as he does on the natural foot.

The studies mentioned would show that the artificial foot furnished with an ankle joint remains longer on the ground during the act of locomotion than is desirable, and that an artificial foot with a rigid ankle joint and the foot itself constructed of elastic material imitates more closely the mechanism of locomotion and, therefore, preferable. Practical observation seems to bear out this notion. The normal foot is an exceedingly complicated mechanism. This can in no sense be duplicated by mechanical means. The office of the artificial foot is to supply a means of locomotion only, and with this principle in mind, the studies quoted above permit of a conclusion which is valuable.

The artificial foot as alluded to seems to be of sufficient importance in connection with the problem to warrant an extended description. The appliance is the outcome of the ingenuity of A. A. Marks of New York who describes his product substantially as follows:

The rubber foot consists of a wooden core, carved to size and shape to secure the best results (Fig. 390). The faint lines in the illustration represent the core which reaches the ball of the foot, localizing the toe movement. The distance from the core to the floor at the heel is considerably greater than at any other part; this is done to obtain the proper degree of compressibility at

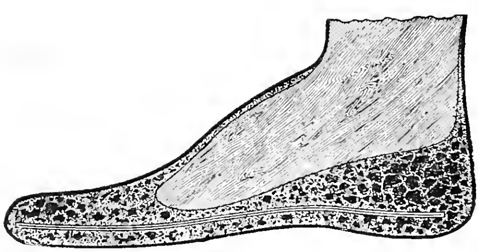


Fig. 390.—Profile View of Rubber Foot.

the heel. The core is entirely surrounded with rubber of great porosity which will yield under the weight of the wearer sufficiently to make the step realistic. Less rubber is placed at the ball so as to provide phalangeal support and create a supporting medium at the front of the foot, ample to steady him when standing, and to act as a lever when walking. A spring mattress is floated in the foot below the core, covering the entire distance from the back of the heel to the tips of the toes, as shown by the lines running lengthwise in the illustration (Fig. 391). The spring mattress is formed by a series of composition strips embedded in strong sail duck, each having a pocket of its own (Fig. 391), the strips occupying the pockets *a, a, a, a.*

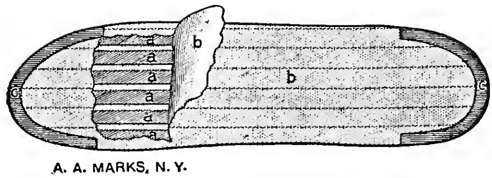


Fig. 391.—Spring Mattress for Rubber Foot.

The spring mattress is a device intended to give additional resilience for both toes and heel. Every movement of the foot when in action, applies pressure to the springs at the heel, ball, or on the sides. The counteracting tendency of the strips aids in forcing the foot back to its proper shape as soon as pressure is removed.

Fig. 392 shows the rubber foot with the weight applied to the ball as it is when the wearer is being urged forward while walking. The spring mattress is now forced upward at the ball and the sponge rubber is compressed above and below the mattress. This pressure pulls the mattress forward in the foot. These movements—the yielding of the spring, the compression of the rubber, and the pulling of the spring mattress forward—form a very powerful resultant force that brings the foot back to its original lines as soon as the foot is relieved of weight.

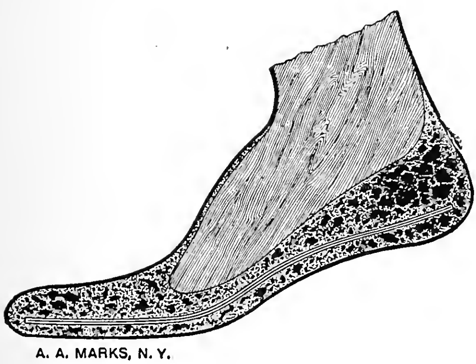


Fig. 392.—Position of Rubber Foot When Walking.

The condition of the appliance when under heel pressure, as it is when the wearer places the artificial limb forward and applies his weight upon it, is somewhat the same. The spring mattress is forced upward, the sponge rubber is compressed above and below, the heel becomes flattened, and the mattress being pulled lengthwise, all combine to force the foot to its shape as soon as pressure on the heel is removed. The compression of the heel permits the toes and the front part of the foot to reach the ground, while the shaft of the leg is obliquely back of the vertical line. Fig. 393 shows the foot on an inclined surface. On account of the yielding quality of the rubber, the up-hill side of the foot will compress and accommodate itself to the incline and allow the foot to remain on its base. This is accomplished without complicated mechanical lateral articulation.

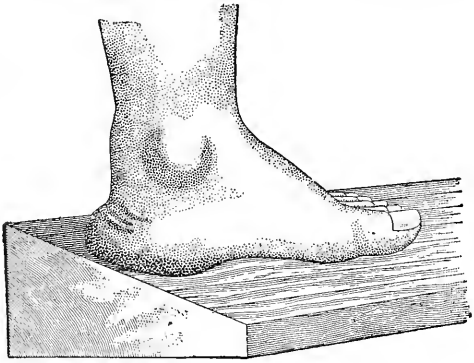


Fig. 393.—Position of Rubber Foot on Inclined Surface.

It can readily be seen that any motion in the ankle that cannot be controlled by the will must be mechanical in action. The approach to the mechanism of locomotion is more positive by their omission.

INSTEP AMPUTATIONS

Instep amputations which include the Lisfranc, Chopart, Hays, Hancock and other methods will be found to call for the application of some device other than the mere padding of the shoe, if the best possible kind of locomotion is to be obtained. It is absolutely useless to apply any form of apparatus in these cases unless the artificial appliance is held so firmly that the wearer may

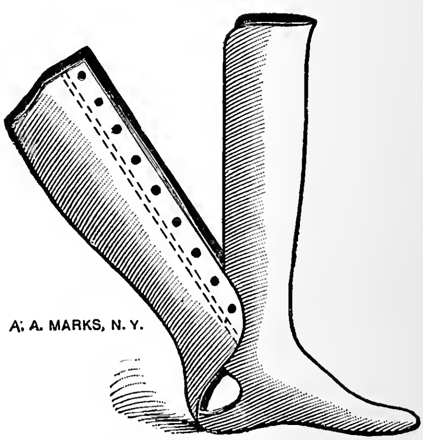


Fig. 394.—Appliance for Instep Amputation.

rise on the ball of the foot, and support his weight while in that position. Fig. 394 shows an appliance which serves the purpose very well. A half leg, or front, including the core of the foot, is made of aluminium, without articulation at the ankle. The rear half is made of leather, shaped to incase the leg and the aluminium shell and hold the appliance in place (Fig. 395). The sole of the foot including the toes is made of rubber with a spring mattress (Fig. 391). Comfortable bearings are provided by proper fittings and suitable linings. The pressure needed to secure firmness is distributed over the entire leg from the ankle to the knee. With this appliance the wearer can rise on the ball of the foot without subjecting to pressure the face of the stump or straining the ankle joint. If there be a tendency to retraction of the heel, the leather sheath at the back is reinforced with metal, shaped to hold the heel down and obviate the deformity. With this appliance in place the wearer walks, striking the heel first, then rolling on the sole until the ball is reached, and then rising on the ball and receiving assistance in walking. Fig. 396 shows the appliance in place with the shoe on and the wearer walking with the weight on the ball of the foot, similar to the position taken by the natural foot when in the act of throwing the body forward.

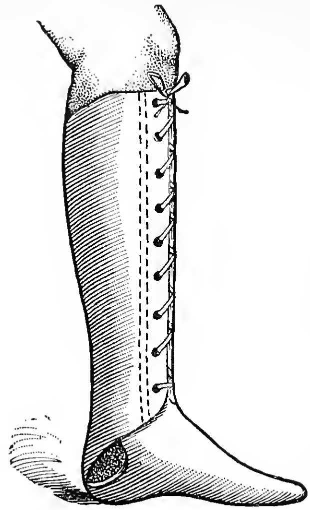


Fig. 395.—Appliance for Instep Amputation in Place.

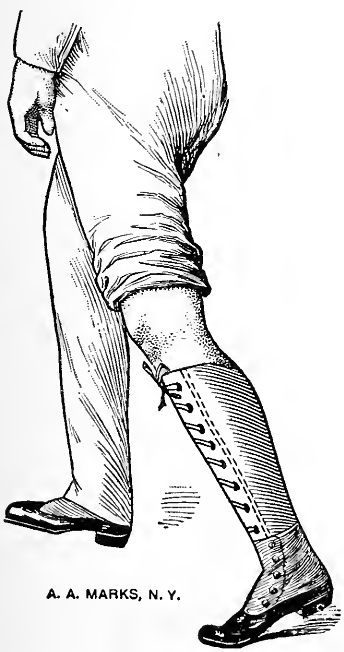


Fig. 396.—Appliance for Instep Amputation in Use.

RETRACTED HEELS

Retracted heels occur as sequels to tarsal amputations which remove the insertion of the muscles opposed to the muscles of the calf. In passing, it might be proper to state that an amputation through the ankle joint or immediately above it is to be preferred to those which do not leave remaining the insertion of the anterior tibial muscles.

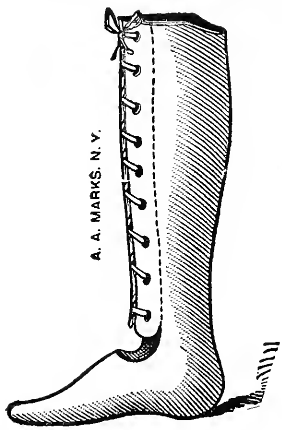


Fig. 397.—Appliance for Retracted Heel following Tarsal Amputation.

The apparatus just described will not meet the indications presented by "retracted heels." Pressure on the face of the stump is not tolerated, and the weight must be borne immediately below the knee or about the thigh. For the purpose the appliance shown in Fig. 397 will be found serviceable in a certain number of cases. The rear half is made of metal, the front of leather, capable of being laced. This permits of close fittings about the heel and tends to force it back to its proper position. If the sides of the leg are sloping, the fitting can be such as to apply all the weight on the leg immediately below the knee. Fig. 398 shows the apparatus applied with the patient sitting. Disuse, atrophy of the muscles of the leg, make the application of this appliance of doubtful utility after a certain period of time following the amputation.

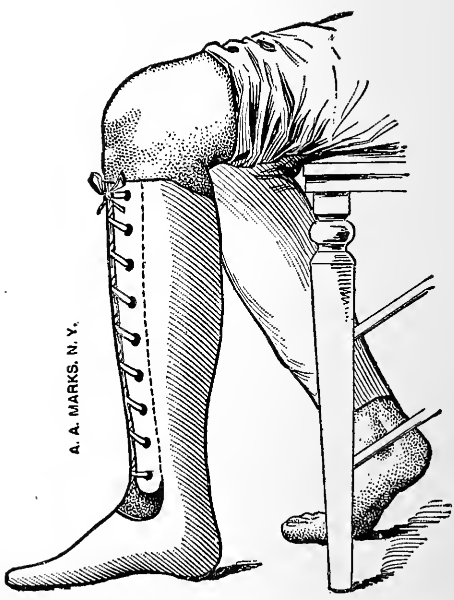


Fig. 398.—Appliance for Retracted Heel following Tarsal Amputation in Place.

When this appliance is not found to meet the indications, it becomes necessary to fit the patient with an apparatus having an annular top or possibly a knee-joint and thigh support. The annular top can be applied to a leg constructed as described. An appliance of this sort is shown in Fig. 399. Knee-joints and thigh supporters can be applied to either kinds of artificial legs. Fig. 400 shows an apparatus with knee-joint and thigh supporter. When the annular top is employed the support is calculated to be localized immediately below the knee. When the knee-joint and thigh support are required as shown in the illustration the lower section is made of aluminium, with the rear sheath of leather. The thigh support incases the thigh and holds it sufficiently firm to obviate slipping of the leg in the socket.

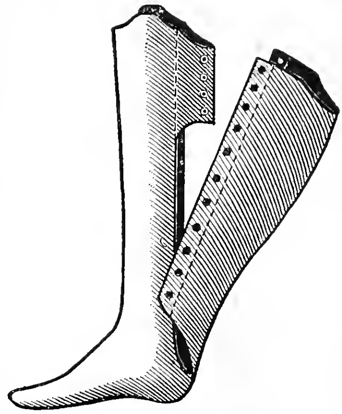


Fig. 399.—Appliance with Annular Top for Retracted Heel following Tarsal Amputation.

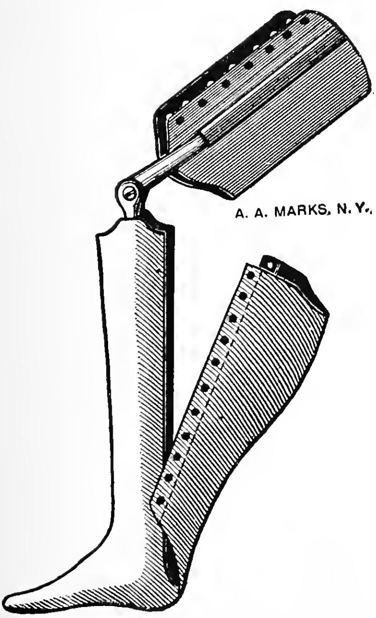


Fig. 400.—Appliance with Knee Joint and Thigh for Tarsal Amputations.

ANKLE-JOINT AMPUTATIONS

Ankle-joint amputations, or so-called tibio-tarsal amputations (*Syme of Pirogoff*), with the malleoli removed and the heel flap utilized over the face of the stump, present conditions exceedingly favorable to the application of artificial apparatus. If the scar be across the face of the stump, they become non-end-bearing stumps; per contra, if the scar be placed anteriorly they are end-bearing stumps, which latter condition is, of course, the most favorable one for prothesis. Fig. 401 shows an appliance suitable to cases with end-bearing stumps. The construction of this appliance is very simple. The front, which is the resisting part, and the core of the foot, are cast in aluminium, the interior surface being formed to receive the anterior surface of the leg from the knee down. It is so fitted that pressure will be distributed over the front area, the shinbone and the soft parts of the leg being protected and not allowed to bear pressure. The rear part is of leather, shaped to fit the calf and back of the leg. It is attached at its lower end to the aluminium socket and when the stump is in place, it incases the whole apparatus from the knee down, holding the leg in place with firmness, the pressure being regulated by the lacing. The foot is of sponge rubber, reinforced with the spring mattress (Figs. 390 and 391). Weight is taken by the end of the stump resting on a surface of proper shape, covered by a suitable pad. The strain resulting from rising on the ball of the foot is not permitted to come on the stump, being distributed over the leg, about the sides of the shin from knee to ankle. A stocking and shoe are drawn over the foot. Fig. 402 shows the appliance in place as stated. If the end of the stump is tender because of sensitive nerve

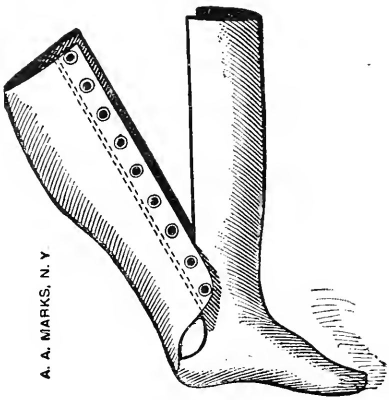


Fig. 401.—Appliance for Ankle-joint Amputations.

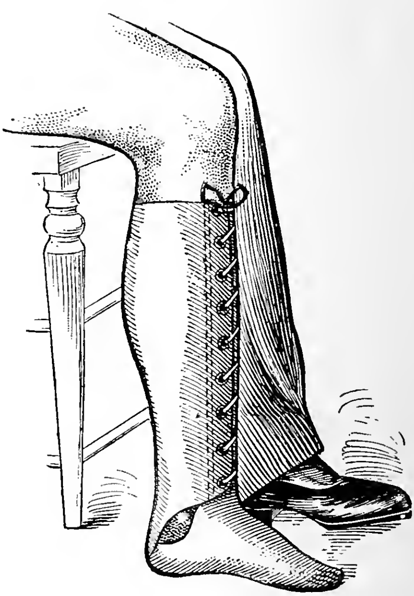


Fig. 402.—Appliance for Ankle-joint Amputations in Place.

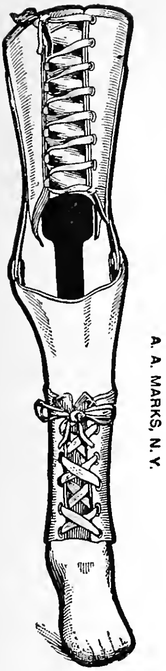


Fig. 403.—Appliance for End-bearing Stumps at Ankle Joint.

endings, or because the scar crosses the face of the stump, an appliance which is supported by an annular arrangement of the upper portion may be used, though this will probably have to be supplemented by a thigh support. Fig. 403 shows the annular arrangement spoken of, which is intended to support the pressure below the knee, but is also fitted with a thigh supporter.

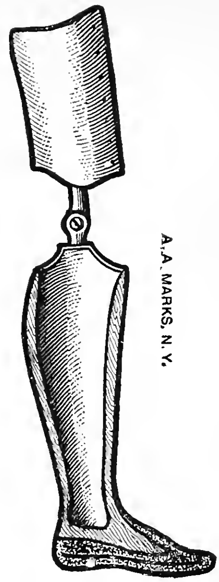


Fig. 404. — Appliance for Tapering Tibial Stump.

LEG AMPUTATIONS

Leg amputations may usually be fitted with artificial appliances similar to those described in connection with amputations at the ankle joint. However, it is desirable to apply an apparatus which does not require lacing at the leg itself, and this is only possible if the stump tapers toward the end. If the distal portion of the remaining stump is wider than any portion higher up, as obtains when the bone section is made below the junction of the middle and lower thirds of the tibia, it will be necessary to use artificial appliances similar to those described under ankle-joint amputations.

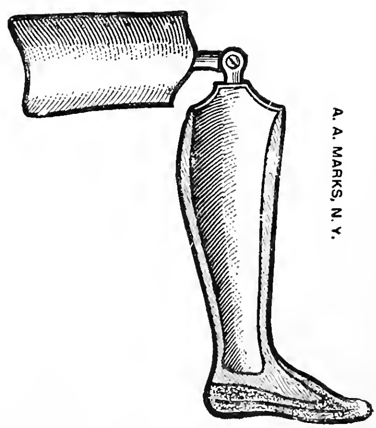


Fig. 405.—Appliance for Tapering Tibial Stumps, Showing Degree of Knee Flexion Obtainable.

Tapering stumps must be fitted with appliances that give ample room for the extremity. That is, the ends are suspended

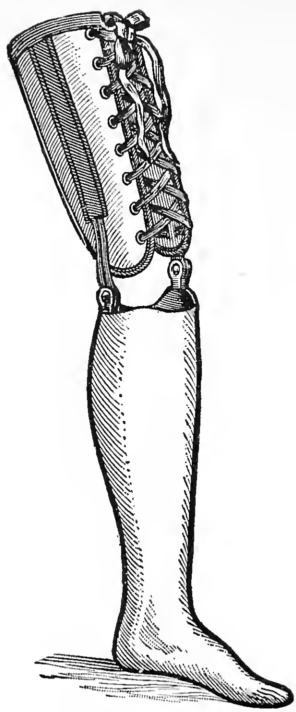


Fig. 406. — Appliance for Short Tibial Stumps.

in space. As they taper towards the ends, they may be inserted from the tops of the sockets, in contradistinction to those just discussed. The socket is hollowed out near the bottom and an abundance of room provided, allowing of free circulation of air. The leg socket and foot core are made of a single piece of wood. The rubber foot is constructed as already shown (Figs. 390 and 391). Figs. 404 and 405 show sectional views of an appliance for the purpose.

Short tibial stumps which are two or more inches in length, with the knee articulation capable of a range of motion through 90 degrees or more, may be advantageously fitted with an appliance shown in Figs. 406 and 407. Fig. 407 shows the appliance with the patient standing, the action of the knee joint being clearly presented.

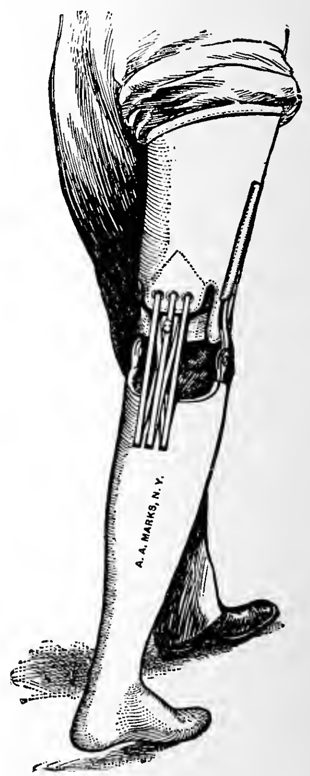


Fig. 407.—Appliance for Short Tibial Stumps in Place. (Posterior View.)

This appliance is constructed as follows: The socket which receives the stump is excavated to accommodate the stump. Sufficient space is allowed for in the socket to allow of circulation of air, and the stump is permitted to hang freely in space. The appliance is made of basswood strongly

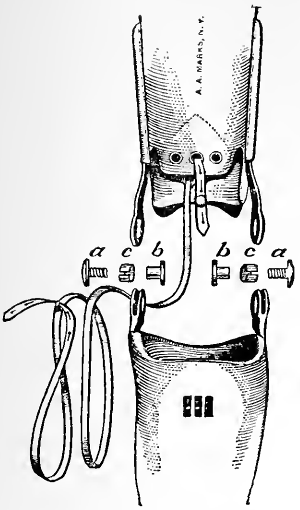


FIG. 408.—MECHANISM OF KNEE JOINT FOR SHORT TIBIAL STUMPS.

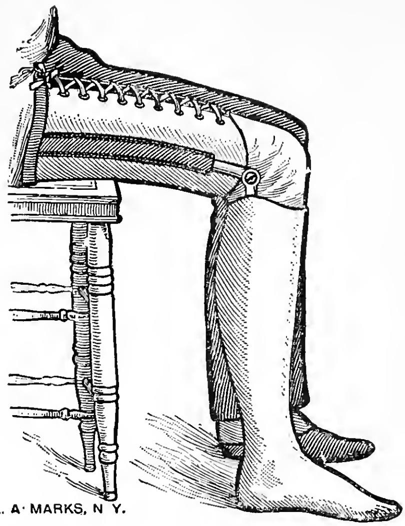


FIG. 409.—KNEE JOINT IN PLACE, SHOWING DEGREE OF FLEXION.

banded together with rawhide. Knee joints are of the ginglymoid pattern. The thigh-piece is made of leather. Fig. 408 shows the upper section of the leg and the lower section of the thigh-piece, with the knee joints disconnected at their articulations; *aa* are screws which hold the bolts *bb* in place; *cc* are the bushings which work on the bolts and receive the wear; a lacing is used to regulate the action of the knee. Fig. 409 shows the apparatus in place with the knee bent.

KNEE-BEARING STUMPS

Knee-bearing stumps are fitted with appliances similar to those just described. A bolt joint fitted with a spring forms the axis of the knee. It is flanged on one end and threaded on the other. When

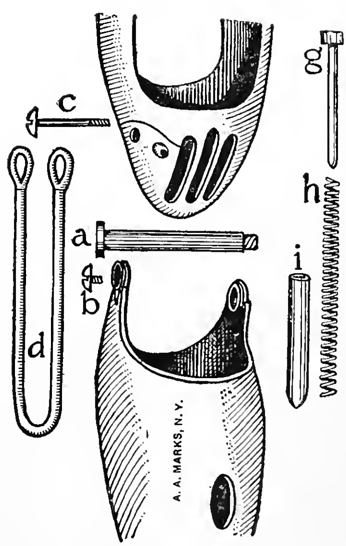


FIG. 410.—MECHANISM OF APPLIANCE IN KNEE-BEARING STUMPS.

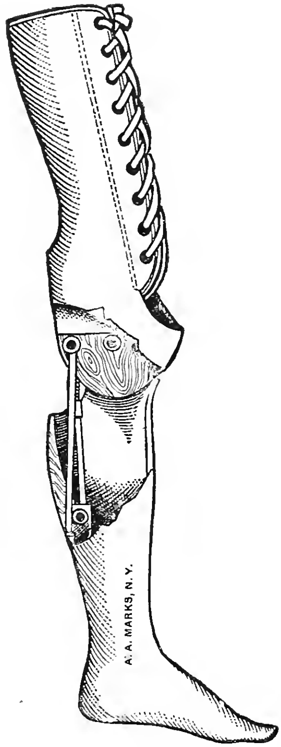


Fig. 411.—Appliance for Knee-bearing Stumps.

the bolt is passing through the metal ear which is riveted to the lower leg, the head sinks into its bed and the threaded end screws into the ear riveted to the opposite side. Fig. 410 shows the mechanism of the apparatus; *a* is the bolt. The set screw *b*, placed into the flanged end, prevents the bolt from moving and working out; *c* is the check cord screw; *d* the check cord; *g* the spring piston; *h* the spiral spring; *i* the cylinder. The relations and functions of these parts can be understood by an examination of Figs. 411 and 412.

The action of the spring holds the leg at flexion when the wearer is seated, and urges the leg forward when walking. The range of articulation can be regulated by means of a pad placed between the lower end of the check cord and the bridge under which it passes. These pads can be reached through the opening in the calf of the leg. The upper loops of the check cords rest in their respective channels and through them a steel screw is passed and set. The center of motion, being placed below the natural knee, causes a disparity in length in the two thighs. This is a minor consideration when balanced against the utility of the mechanism.

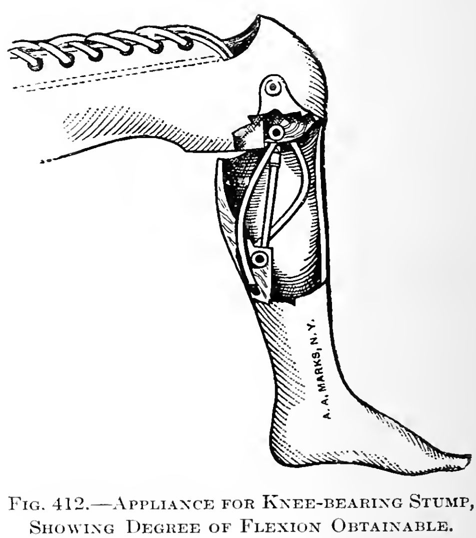


Fig. 412.—Appliance for Knee-bearing Stump, Showing Degree of Flexion Obtainable.

Disarticulated knee stumps are fitted with practically the same appliances described under "knee-bearing stumps." It may be said that disarticulations at the knee joint bear pressure very well and present a condition of affairs quite favorable to prothesis.

THIGH STUMPS

Thigh stumps are fitted with much the same appliances as are applied to knee-bearing stumps. The application of an artificial limb should not be postponed beyond what is necessary to obtain a tolerant stump. Persons who carry an idle thigh stump for a considerable period of time usually have a certain degree of contracture of the flexor muscles (the psoas, etc.) which inclines the stump forward, and this must be overcome before a comfortable appliance can be advantageously worn. As a rule thigh stumps will not bear pressure on their ends. Fig. 413 shows the usual form of artificial limb applied to thigh stumps; Fig. 414 shows a rear view of the same. A rubber foot as already described is attached at the ankle, and the leg portion is hollowed out to decrease weight. Fig. 415 shows the parts of the knee mechanism. A is the T-joint which is secured to the knee-block located at the lower end of the stump socket. The two arms work in journals made in the leg section; *bb* are the cap screws that hold the T-joint

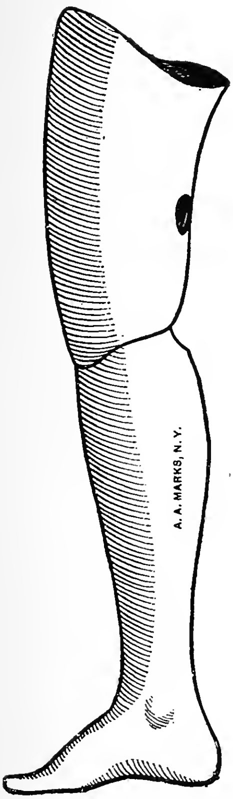


Fig. 413. — Appliance for Thigh Stump. (Lateral View.)

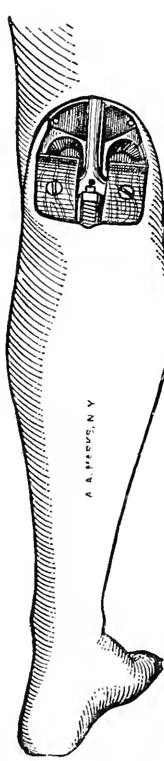


Fig. 414. — Appliance for Thigh Stump. (Posterior View.)

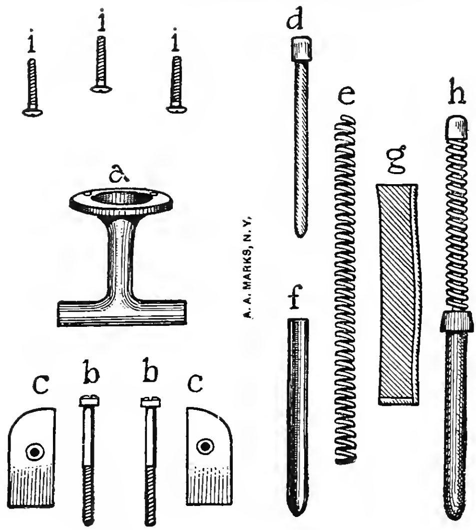


Fig. 415.—Mechanism of Knee Joint in Appliance for Thigh Stump.

to its place; *cc* the caps; *d* the spring piston; *e* the spiral spring; *f* the cylinder cover, and parts of the spring together; *iii* represent the steel screws used to hold the T-joint firmly to the thigh. The joint *a* has the shape of an inverted T, hence its name, T-joint. When the leg and thigh sections are placed together, the arms of the T-joint rest in boxes and are held by two hardwood caps, *cc,* which are secured by long screws, *bb*, which depend for their security on steel nuts, imbedded in the front part of the leg. The pressure of the caps on the joints can be regulated by the screws; thus any desired tension on the articulation can be made. The steel lever with ball on the end, projecting from the back of the joint, operates in the cavity of the hardwood piston *d;* the piston is inserted in one end of the steel spring, *e,* which has its lower part incased with leather, and then placed in a metal cylinder *f.* The lower convex end of the cylinder is received on a bridge placed in the interior of the leg in the region of the calf. The operation of the spring is twofold; it urges the lower leg forward in walking, and holds it at full flexion when sitting. This is done in the following manner: When the leg is extended, the point at which the spring pressure is applied is on the end of a steel lever projecting an inch back of the center of motion in the knee. This urges further extension (Fig. 416), the lever revolves with

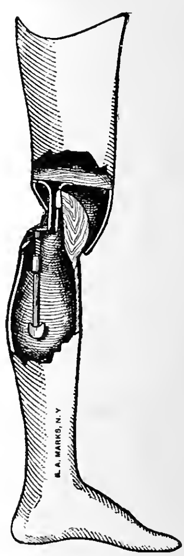


Fig. 416.—Appliance for Thigh Stump. Knee in Full Extension.

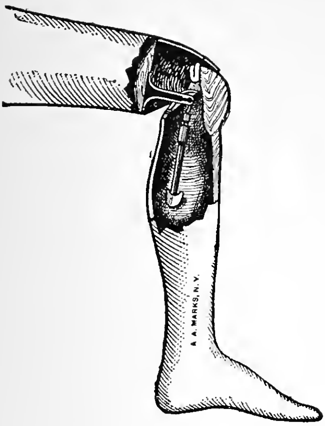


Fig. 417.—Appliance for Thigh Stump. Knee in Partial Flexion.

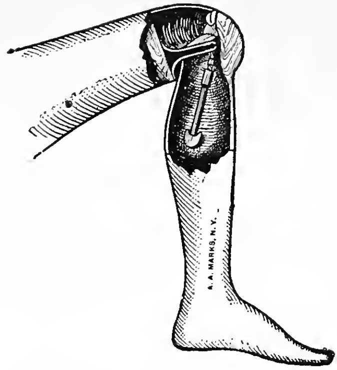


Fig. 418. — Appliance for Thigh Stump. Knee in Full Flexion.

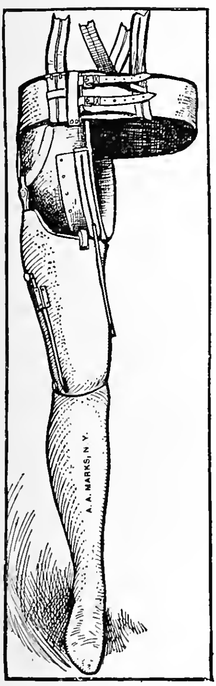


Fig. 419. — Appliance for Hip Amputation. (Anterior View.)

Fig. 420.—Appliance for Hip Amputation. (Posterior View.)

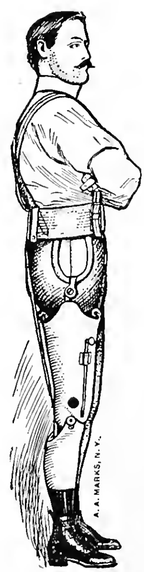


Fig. 421. — Appliance for Hip Amputation. (Lateral View.)

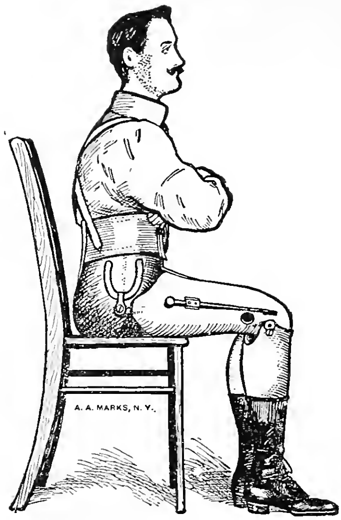


Fig. 422. — Appliance for Hip Amputation. (Patient Sitting.)

the joint, and when the leg is partly flexed (Fig. 417), it has been carried to a neutral point where the spring neither urges flexion nor extension, but when the knee is farther flexed (Fig. 418), the lever has passed forward of the neutral line and the spring forces the ball upward, urging farther flexion, and when the flexion is at its limit, the leg is kept in that position by the spring. Thus, the objection to the usual spring knee articulation is removed, that of the tendency of the leg to fly out when the wearer is sitting and unguarded.

HIP-JOINT AMPUTATIONS

Hip-joint amputations require conditions of apparatus quite similar to that just described, except that suspension is more complex. For the purpose an appliance such as is shown in Fig. 419 is serviceable. The waist belt and suspenders hold the limb in apposition to the pelvis. Figs. 420, 421, and 422 show the appliance in place. The latter shows the conditions when the patient is seated.

Fig. 423.—Appliance for Amputation of Hand.

AMPUTATIONS OF UPPER EXTREMITIES

Artificial appliances following amputations at the upper extremities do not, of couse, involve quite the same problem as obtains with those of the lower extremity. Cosmetic effect plays an important part in this connection, and this is readily conserved by mechanical means. Amputation of the hand lessens greatly the utility of the limb. However, if the forearm is intact, an artificial appliance such as is shown in the illustration (Fig. 423) will be found of service. Amputations through the forearm are fitted with much the same style of apparatus.

Amputations above the elbow joint are fitted with an appliance which is fitted with a spring permitting of flexion of the elbow. Fig. 424 shows an apparatus of this sort. Disarticulation at the shoulder joint is also followed by the application of apparatus which conserves cosmetic effect, but, of course, utility is not achieved by this means, except by the exercise of a complicated mechanism which is of necessity operated for a given purpose by the opposite hand.

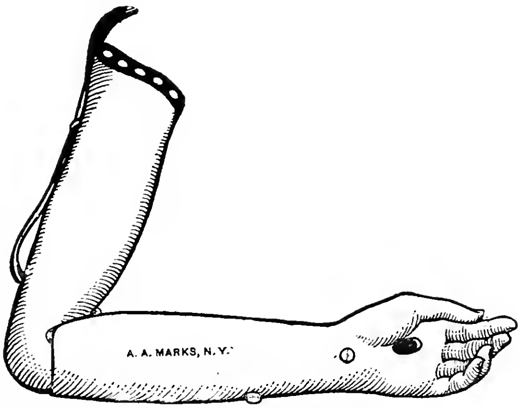


FIG. 424.—APPLIANCE FOR AMPUTATION OF ARM.

The greatest achievement in the part of artificial appliances following amputations is the aid given the afflicted in locomotion. In addition to this, the usefulness of certain kinds of stumps in various portions of the limbs as applied to subsequent prothesis has been developed to no small degree, as the outcome of the artisan's labor. It is to be regretted that more attention has not been paid to this portion of the problem in teaching operative surgery. The general surgical rule that every inch of limb should be saved is not uniformly wise. A perusal of the discussion offered above may lead to some valuable conclusions in this connection. The problem of what occupation the afflicted person is to follow should enter into the question and, if this be borne in mind, no doubt reamputation will become less frequently necessary.

CHAPTER XXXIV

MISCELLANEOUS OPERATIONS

Fracture of the patella—Union of fractured bones—Nailing the neck of the femur—Skin-grafting.

FRACTURE OF PATELLA

Fracture of the patella when treated by operative measures of relief presents a problem in which the question of infection plays a more important part than obtains in other portions of the body, when the condition for which relief is attempted is balanced against the dire results of the infection. For some unknown reason the knee joint is peculiarly susceptible to infection, and also for an unknown reason its occurrence results fatally at times, and often in complete loss of function of the joint. For this reason especial precautions should be taken against the introduction into the wound of infectious substances, and, whatever may be said of the question of wearing gloves when the surgeon operates in other portions of the body, they should be worn by the operator and his assistants when the knee joint is invaded.

The technic of the operation does not call for special adroitness nor the exercise of *finesse* in manipulation, and the gloves need not be regarded as hampering the operator in the least. Again, the operation does not call for the exercise of prolonged physical exertion, and the temperature of the operating room need not be high, consequently the surgeon is not caused to perspire freely, as obtains during operations of greater magnitude, and the objection to the use of gloves on the score that accidental perforation might liberate into the field sweat infested with bacteria from the skin of the operator's hands need not be taken into account.

In other respects, the field of operation is prepared in a manner similar to that employed in other portions of the body. When the region of the knee has been injured by the force causing the fracture, healing of the trauma should be complete before the operation is undertaken, or, if this be regarded as an objectionable delay, the solution of continuity in the skin should be sterilized with pure carbolic acid and alcohol immediately before section of the skin is made. After the apposition of the fragments is completed, the superficial wound is closed with silk-worm gut. The joint is not drained as a rule. In some instances a small drain is carried through the skin from the dependent portion of the joint, *i.e.,* at its external aspect. However, the use of drainage in this class of cases is objectionable and may constitute an avenue of entrance of infection. If drainage is employed, horsehair or silk-worm gut are the most useful and least objectionable agents for the purpose. After the skin wound is closed the usual protective dressing is applied, though in this situation it is well to be somewhat lavish in the use of gauze, in order to permit of an equable application of the immobilizing apparatus.

The limb may now be placed on a posterior splint. It will be found, however, that plaster-of-Paris is the best dressing to use for the purpose. The patient is placed in bed with the thigh flexed upon the pelvis and the leg supported by pillows. The quadriceps extensor is thus relaxed and strain upon the approximation sutures which hold the fragments in apposition is avoided. If drainage has been employed, a window is cut into the plaster cast on the third day following the operation, which corresponds in size and location to the site of egress of the drain, which is located some distance from the wound of approach to the site of fracture, thus minimizing the danger of the introduction of infection at this time. The drainage wound is redressed at once. On the tenth day after the operation the cast is cut down, the stitches removed from the skin, and, after cleansing, under aseptic precautions, the entire knee and contiguous parts the cast is reapplied to the limb and held in place by encircling strips of adhesive plaster. The posture of the limb as previously employed is reassumed. At the end of another three days the wound is again dressed. At this time the attendant grasps the patella between the thumbs and forefingers of both hands, holding firmly the fragments in position (Fig. 425), and moves it carefully from side to side. The object of this manipulation is to avoid adherence of the posterior surface of the patella to the condyles of the femur. If this can be avoided, the subsequent manipulations destined to restore motility in the joint are less liable to cause refracture.

FIG. 425.—LATERAL MANIPULATION OF PATELLA TO OBVIATE ADHERENCE TO CONDYLES OF FEMUR.

Normally the patella glides on the smooth surfaces of the condyles, and if it becomes adherent, it is easy to see how an effort to flex the leg would cause the line of union to give way.

The limb is now immobilized in a new plaster cast, in which it is allowed to remain for three weks. At this time the cast is cut down, the patella moved again laterally as described, and the cast fastened back in place. Complete immobilization is now no longer necessary. Each day the cast is removed and lateral manipulation of the patella practiced, but at this time flexion of the limb, either passively or actively, is to be avoided. The latter is to be avoided until seven weeks after the operation, and at first the patella should be steadied as the leg is cautiously and carefully bent. As a rule, no attempt to obtain complete flexion of the joint should be attempted until after the expiration of twelve weeks after the operation. In the meantime the limb should be massaged daily. If infection of the joint occurs, the cast must be cut down, the wound completely opened, drainage established and the joint treated as infected joints are taken care of from other causes.

UNION OF FRACTURED BONES

The union of fractured bones by holding in apposition the fragments by means of wire, nails, pegs or similar device is followed by drainage in most instances. The use of the drainage is governed by much the same rules which are applicable to wounds generally, except, perhaps, that in this class of cases the oozing of blood from the traumatized bone may be regarded as a special indication for its use. After the protective dressing is applied,

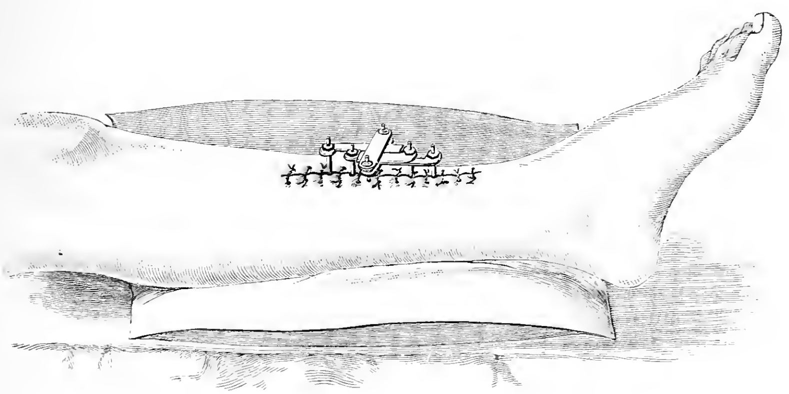


FIG. 426.—*Parkhill's* SCREWS *in situ*. (*Bryant*.)

the bone and contiguous joints are immobilized in plaster-of-Paris, and on the third day following the operation the drain is removed through a small window cut into the cast for the purpose. On the tenth day after the operation the window in the cast is enlarged and the sutures removed from the wound. The wound is then dressed, and in most instances need not be disturbed until the cast is cut down for some other purpose. If there be a superficial infection, the dressing is changed every two days until healing takes place. In instances where long bones, such as the tibia cannot be held in proper apposition, a devise employed by *Parkhill* is frequently introduced into the fragments. When the device is *in situ* it presents the conditions shown in Fig. 426. This method of treatment renders the application of a plaster cast a trifle more complicated, as the instrument protrudes through the plaster cast and constitutes an avenue of entrance of infection. This may be obviated by covering the device with an additional dressing independently of the cast. The latter precaution must not be neglected. The wires and pegs are not always well borne and at times cause irritation and must be removed. The appearance of redness, pain and swelling at the site of the operation, several weeks after the repair has been made, suggests that the foreign substance is causing trouble and should be removed. Nails are usually left protruding from the soft parts, and should be removed five weeks after the operation. *Parkhill's* device should be removed at the expiration of the same period of time.

The principle of treatment in these cases is quite similar to that applicable to fractures generally. The wound may be regarded as wounds are in a general way, except, perhaps, for the variations from the rule mentioned above. In a certain number of cases a superficial necrosis of bone corresponding in extent to the perforations made by the retaining apparatus occurs, a small abscess forms and a sinus persists for some time after the operation. This need not be regarded as a serious complication, nor indicative of failure of the measure of relief. It means, however, that the wound needs to be cleansed at intervals of two days through the window in the plaster cast, and may, indeed, demand somewhat protracted attention after the case has recovered in all other respects. An application of tincture of iodin to the sinus at intervals of four or six days will at times stimulate granulation and destroy mild infection.

NAILING THE NECK OF THE FEMUR

Nailing the neck of the femur for fracture is practiced in a certain number of cases where immobilization by mechanical means is contraindicated, because of the age of the patient, or because of the coexistence of some complications precluding the employment of the more usual methods of treatment.

As a rule, the fixation of the fragments by nailing is followed by the application of a plaster-of-Paris cast which consists of a hip spica extending down to but not including the knee joint. The wound which permits of the introduction of the nail does not require drainage, and the hip joint may be immobilized and the dressing left undisturbed for two weeks following the operation. In a small number of cases it may be necessary to cut a window into the cast corresponding to the point of insertion of the nail in order to cleanse the area. However, this will only rarely be necessary.

The patient is permitted to leave the bed, and is encouraged to go about on crutches after the third day following the operation. The cast, as already stated, is removed at the end of two weeks following the operation, and the nail may be relied upon to hold the fragments in apposition after this. The hip joint may be lightly dressed with sterile gauze held in place with a roller bandage. The nail is removed at the end of six weeks following the operation. The nail is left protruding from the skin at the time of the operation, and, for the purpose of removal, it is firmly grasped by a strong forceps and slowly twisted until it becomes loosened when it is readily removed with slight traction. As a rule, a slight degree of necrosis corresponding to the seat of the nail causes it to be quite loose at the end of the six weeks mentioned. If the nail be firmly fixed and do not permit of easy removal, it may be grasped near its head by a strong hysterectomy clamp and this given a sharp blow in the direction away from the limb with an ordinary mallet, such as is used for gouging bone.

In most cases the wound heals immediately after the nail is removed. In a few cases, however, a sinus persists for several weeks after the nail has been withdrawn. This, as mentioned in connection with the wiring of fractures, need not give rise to any alarm, and the sinus actually heals in a short time. Infection should not occur in these cases. If it happens, however, the nail must be at once removed, and drainage established.

A certain degree of motility of the joint occurs at the end of the two weeks of treatment, and this will be found to be sufficient to obviate complete ankylosis. However, the motion in the joint will be found much impaired after healing is achieved. At the end of the six weeks, the joint is subjected to passive motion and massage as employed following fractures in general. It is not wise to employ very largely measures destined to obviate ankylosis until after union has taken place. Indeed, the nail, while meeting the indications when treated with care, will not be found to hold the fragments in place when the joint is subjected to passive motion too early in the postoperative period. It is best to permit the patient to move the joint only as much as is the inevitable outcome of going about in the ward on crutches. As this operation is usually undertaken on patients advanced in life, the precautions with respect to hypostatic pneumonia and bed sores are to be observed. As far as the former is concerned, the patient must be caused to leave the bed or at least be raised to the sitting posture as soon after the operation as is possible. The latter, of course, is a question of frequent change of posture and attention to the skin.

SKIN-GRAFTING

Skin-grafting is undertaken, in the vast majority of instances, for the relief of conditions when infection to a greater or lesser degree already exists. This factor in the problem would suggest the employment of antiseptic measures throughout the care of the case. However, the repair of the wound is dependent upon the vitality of the grafts, and as this is more or less impaired as the result of contact with antiseptic solutions, the operative technic must be carried on without the employment of these agents.

The local preparation of the patient may be carried out with antiseptics, and, indeed, these may be liberally used at this time. However, immediately before the operation all antiseptics must be removed before the grafts are brought in contact with their new residence. For the purpose, the parts are cleansed in the usual manner and ultimately a liberal lavage made with normal salt solution. During the operation, normal saline solution should be used as a cleansing fluid. The salt solution is regarded as a contributing factor to the maintenance of the nutrition of the grafts.

On the other hand, great care must be taken to avoid accidental contamination of the operative field, for, while the use of salt solution may contribute to the vitality of the grafts, it also constitutes a culture medium exceedingly favorable to the growth of bacteria, a fact borne out by the rather virulent character infection takes on when developed under the conditions presented.

One of the most prolific causes of failure in achieving a favorable ultimate outcome in these cases is the fact that the protective dressing becomes adherent to the grafts, and when it is removed the grafts are torn away. This applies with equal force to *Thiersch, Riverdian* or other grafts. To avoid this, the protective dressing is kept constantly moist with normal salt solution, the theory being that the gauze will not adhere to the grafts under

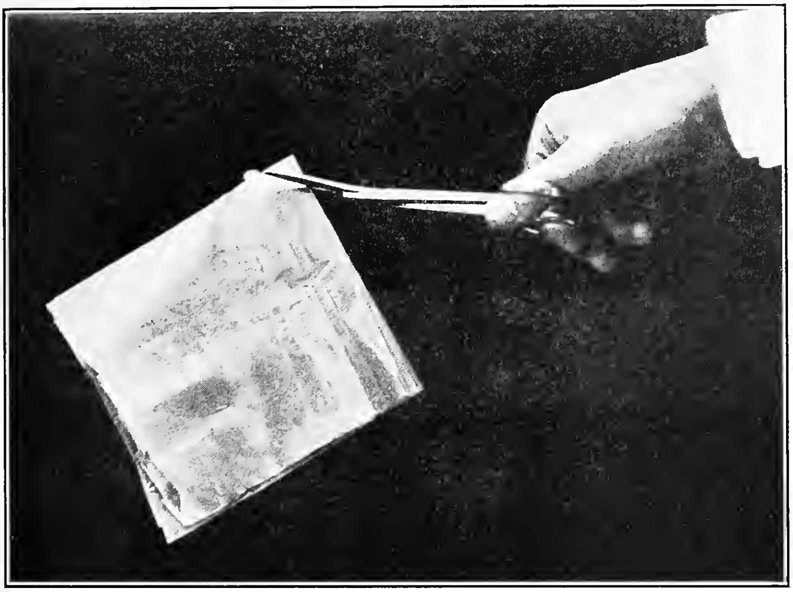


Fig. 427.—Method of Preparing Rubber Tissue for Dressing Wound after Skin-grafting.

these conditions. This has not been found to achieve the object, and in addition the moist dressing constitutes a condition very favorable to the entrance of infection.

A method which has yielded the best results is as follows: After the wound is thoroughly dried, rubber tissue is cut to a suitable size, and this is fenestrated at intervals of a square inch by first folding the tissue and then excising diamond-shaped portions in the manner shown in Fig. 427. When the entire portion of tissue is prepared, it presents a condition shown in Fig. 428.

The wound is now covered with sterile olive oil and, after the rubber tissue has also been submerged in sterile olive oil, it is

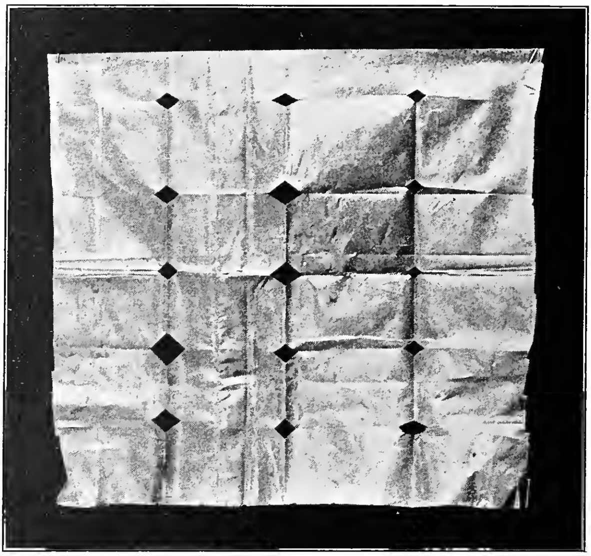


Fig. 428.—Rubber Tissue Prepared for Application to Wound after Skin-grafting.

Fig. 429.—Fenestrated Rubber Tissue Applied to Wound after Skin-grafting.

applied directly to the wound. Whatever secretion the wound may throw off finds its way into the protective dressings through the diamond-shaped openings. Fig. 429 shows the rubber tissue applied. The square of gauze (Fig. 187) applied directly contiguous to the rubber tissue is also saturated with the sterile oil, and outside of this the usual protective dressing is applied.

When the dressing is changed, which should be done every forty-eight hours subsequent to the operation, the rubber tissue is readily removed without damage to the grafts. At the end of the third dressing the collection of oil adherent to the wound and contiguous skin may be removed by gently swabbing the surface with tincture of green soap applied by means of a cotton pledget and the resultant lather removed by liberal lavage with sterile water or salt solution.

In most cases sloughing of a portion of the grafts takes place. This will become manifest at the end of a week and is accompanied by a liberal discharge of offensive secretion. By this time, however, the healthy grafts will have become sufficiently adherent to warrant employment of a mild solution of carbolic acid (1 in 250) as a cleansing solution. The carbolic acid solution should, however, be ultimately displaced with sterile water, and under no circumstances should a wet dressing containing an antiseptic be permitted to remain in contact with the wound before the total number of grafts have become adherent, unless the wound present evidence of infection.

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